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This descriptive study examined the perceptions of new graduate registered nurses (RNs) about medication error identification, causes, and reporting; as well as the nursing education and workplace orientation experiences they believed prepared them to safely manage medications. The study also explored how prelicensure RN nursing education and hospital orientation programs in North Carolina (NC) prepared nurses to manage medications safely. The theory of situated cognition provided the organizing framework. Data were collected from the three participant groups (new graduate RNs, schools of nursing, and hospitals) using online surveys, and respondents included 131 new graduate RNs, 35 schools of nursing, and 20 hospitals/hospital systems in NC.

Descriptive analyses of data from the modified Gladstone scale revealed that nurses were confident in their ability to identify and report a medication error, but inconsistently identified or reported errors when presented with medication management scenarios. Distinct differences were found between the content topics, teaching strategies, activities, and equipment used by nursing education and workplace orientation programs to teach or review medication management and what was identified as effective preparation experiences by new graduate RNs.

An opportunity for improvement in nurse preparation for safe medication management was identified based on the differences between nurse-reported effective experiences for safe medication management preparation and what is being provided by nursing education and orientation programs. Implementing teaching strategies students

identified as effective, such as increasing interactive experiences, use of real-world case scenarios, and clinical problem-solving, into the classroom may create a better fit with current student learning styles and ultimately safer nursing care.

AN EXPLORATION OF REGISTERED NURSE PREPARATION
FOR SAFE MEDICATION MANAGEMENT

by

Catherine Illman Sykes

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To my husband, friend, and soulmate Bill, because without your loving patience, support,
and encouragement, this journey would never have been completed.

To my son Nate, for all the hugs and caring questions that have helped me persevere.

To my late parents, Grace and Walter Illman who instilled in me a love of learning and an
insatiable curiosity about the world around me.

APPROVAL PAGE

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CHAPTER I

INTRODUCTION

In 2000 the Institute of Medicine (IOM) issued an urgent call for health care reform in their seminal work *To Err is Human: Building a Safer Health System* (Kohn, Corrigan, & Donaldson, 2000). Despite a heightened awareness of the need to improve patient safety, medical errors are currently the third leading cause of death in the United States (US), closely following heart disease and cancer, with more than 400,000 people dying each year due to preventable harm (James, 2013; Makary & Daniel, 2016). Even more disturbing than the mortality figures, serious harm from health care is reported as being 10 to 20 times more frequent than death (James, 2013). Health care professionals and organizations clearly have a long way to go to create a safe health care system.

Almost 5% of all hospitalized patients are affected by an adverse drug event, making them one of the most common types of error in the inpatient setting (Agency for Healthcare Research and Quality, 2015). Numerous causes of medication errors have been identified, including slips and lapses, safe practice deviations, knowledge deficits, workload, interprofessional concerns, and system issues (Agency for Healthcare Research and Quality, 2015; Donaldson, Aydin, Fridman, & Foley, 2014; Keers, Williams, Cooke, & Ashcroft, 2013; Lawton, Carruthers, Gardner, Wright, & McEachan, 2012; Niemann et al., 2015), and a variety of interventions have been used to

reduce errors rates both through regulation and organization-driven initiatives, such as drug labeling and naming (US Food and Drug Administration, 2015), implementation of technology, reducing interruptions and distractions, and development of a culture of safety (Andrew & Mansour, 2014; Cousein et al., 2014; Donaldson, Aydin, & Fridman, 2014). Unfortunately, because there is a lack of coordination throughout the US health system these interventions have not been implemented in an organized, standardized fashion. The lack of harmonization of interventions has stifled improvements in error-reduction and made it more difficult to identify the most effective strategies to deal with error-causing situations.

Approximately 25% of medication errors occur in the preparation, administration and monitoring phases of medication management. These phases of the process are generally carried out by the registered nurse (RN) (Agency for Healthcare Research and Quality, 2015). This puts RNs in a challenging position because they often have the last opportunity to intervene before an error reaches a patient. Because they are usually the last link in the chain, RNs often become the first “suspect” when an error occurs. Even though the medication management process is complex, involving various health professionals, and errors have been shown to be a result of human factors, system, and environmental issues (Parry, Barriball, & While, 2015), the fact remains that the nurse is a critical link in patient safety. In light of the key role of the nurse, it is essential that all nurses receive comprehensive and effective medication management education in their prelicensure nursing program, with focused review during workplace orientation. Unfortunately, there is almost no information in the literature on best practices, or even

effective strategies, for medication management education. Although the most effective way to prepare new nurses to safely manage medications is not known, it is clear that, based on error causes and rates, it is critical to discover how RNs are currently being prepared to ensure their education leads to safe and competent practice.

Before improvements can be implemented in prelicensure nursing education or orientation programs, it is important to understand what is taking place in these programs related to safe medication management, and the perceptions new nurses have developed about medication errors and their causes. Because of the nurse's pivotal role in medication management and the significant impact of human factors on errors, it is important to not only know what is being taught about safe medication management but how the information is interpreted and applied by the nurses who have received the instruction. Exploratory research in these areas will be invaluable in creating a foundation for program change ultimately leading to improvements in safe medication management.

This chapter includes a discussion of the background and significance of medication errors, with highlights from the current literature. The purpose of this study will be identified and how the theory of situated cognition will be used to frame achievement of the study's purpose. The specific aims and research questions will be delineated, along with definitions of key terms and study assumptions.

Background and Significance

There is a worldwide concern about patient safety related to medication errors (Aspden, Wolcott, Bootman, & Cronenwett, 2007; Centre for Health Systems and Safety

Research, n.d.; National Institute for Health and Care Excellence, 2015). Reduction of error rates is important because it is an indicator of the quality of care being provided. The pivotal work by the IOM, *To Err is Human: Building a Safer Health System* (Kohn et al., 2000), identified how errors not only cause additional suffering, extended hospitalizations, and even death, but also increase costs to individuals, insurers, and healthcare organizations. A subsequent IOM report, *Preventing Medication Errors: Quality Chasm Series* (Aspden et al., 2007), highlighted the lack of progress in reducing medication errors and gave specific recommendations to improve the safety of medication prescribing, dispensing, preparing, administering, and monitoring. At the time of the report, it was estimated that more than 1.5 million individuals in the US were affected by medication errors annually, impacting 5-10% of all patients and causing the deaths of more than 7000 people each year (Aspden et al., 2007). These numbers are only a fraction of the errors and subsequent injuries and deaths reported today (James, 2013). Some of this difference may be from more accurate reporting as a result of the widespread implementation of electronic health records (EHRs), some due to an aging population with increased comorbidities, and some as a result of other changes in the US health system. The important point is that medication errors continue to be an issue that needs attention by organizations and individuals alike.

Medication management is a complex process involving multiple steps and a variety of health care professionals. In an acute care setting this generally includes at least a pharmacist, a nurse, and a provider, e.g., physician, nurse practitioner, or physician assistant. The transition from paper medical records to EHRs has resulted in

significant improvements in medication order accuracy and appropriateness during the prescribing and dispensing steps of medication management (Bates et al., 1998, 1999; Castlight Health, n.d.), but it has not been a perfect solution. Any automated system is only as good as the programming that runs it. A recent study by the Leapfrog Group (Castlight Health, 2016) showed that the use of computerized order entry could decrease potential medication errors through the use of clinical decision-support tools which flagged orders with wrong drug doses, allergy contraindications, or drug incompatibilities, but if the appropriate data were not programmed into the system the flags would not display. Even though technology can assist in reducing human errors, it is not a substitute for clinical judgment. It is still the health care professional who is responsible for the medication ordered or the pill administered.

Fundamental challenges in applying research evidence to reducing medication errors have been the variety of definitions of “medication error” used in studies (Oshikoya et al., 2013) or the lack of a reported definition (Keers et al., 2013). Some researchers stated they considered any actions that differed from physician’s orders, manufacturers’ instructions, or organizational medication management policies as a medication error (Headford, McGowan, & Clifford, 2001; Keers et al., 2013) and others used specific criteria, such as omission, unauthorized drug, wrong time, etc., with detailed definitions (Acheampong, Tetteh, & Anto, 2015; Donaldson, Aydin, & Fridman, 2014). Fortunately, increasing numbers of investigators are following the advice of the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) and using the organization’s definition in their research (Dehghan-Nayeri, Bayat,

Salehi, & Faghihzadeh, 2013; M. L. Durham, Suhayda, Normand, Jankiewicz, & Fogg, 2016). The NCC MERP definition is also used by the US Food and Drug Administration (2016) when identifying medication errors. To bring about systematic change it is important for everyone involved in addressing the problem of medication errors to work from a common definition (Grober & Bohnen, 2005).

The NCC MERP (2016) urges the following definition of medication errors be used by researchers, software developers, and health care organizations.

A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use. (para. 1).

Although errors can occur at any stage in the medication management process: prescribing, dispensing, preparing, administering, or monitoring (Aspden et al., 2007), this study focused on preparing, administering and monitoring, the steps most pertinent to the practice of RNs.

In addition to working from a clear definition of medication error, it is also important to understand the various causes of errors, including errors of both commission and omission. The NCC MERP Taxonomy of Medication Errors (1998) provides an overarching framework of the errors described in its five categories of causes for medication errors (communication, name confusion, labeling, human factors, packaging/design) and 14 contributing factors (lighting, noise level, frequent

interruptions and distractions, training, staffing, lack of availability of healthcare professional, assignment or placement of a healthcare provider or inexperienced personnel, systems for covering patient care, policies and procedures, communication systems between healthcare practitioners, patient counselling, floor stock, preprinted medication orders, other). These causes and contributing factors have been validated in numerous studies around the world (A. Johnson, Guirguis, & Grace, 2015; M. Johnson & Young, 2011; Kandil, Sayyed, Emarh, Ellakwa, & Masood, 2012; Karavasiliadou & Athanasakis, 2014; Keers, Williams, Cooke, & Ashcroft, 2015; Parry et al., 2015).

Some of the challenges with many of the studies done to date include small, convenience samples, single site investigations, and a reliance on self-reporting and recall of errors made, rather than observation, chart review, or review of data from error reporting systems (Mrayyan, 2012; You, Choe, Park, Kim, & Son, 2015). Observation has long been seen as the “gold standard” for measuring medication administration error rates (Meyer-Masseti et al., 2011), but this method is time-consuming, resource-intensive, and subject to the Hawthorne Effect, where the observer causes a change in the behavior of the observed just by bringing a particular issue to their attention and potentially introducing observation bias (Campino, Lopez-Herrera, Lopez-de-Heredia, & Valls-i-Soler, 2008; Keers et al., 2013; McCambridge, Witton, & Elbourne, 2014).

Gathering complete and accurate error data has also been found to be difficult. Some researchers have reported that errors rates measured by reporting systems are often much lower than found using observation or chart audit (Westbrook et al., 2015; Zhan et al., 2008), yet many organizations are relying on reporting systems for data on incidence

and causes of errors. A persistent problem in some parts of the world is the lack of, underdeveloped, and/or underutilized error reporting system (Cebeci, Karazeybek, Sucu, & Kahveci, 2015; Fahimi et al., 2008; Mostafaei et al., 2014). Even when a reporting system is in place several studies discussed that some health professionals don't realize they have made an error (Barker, Flynn, Pepper, Bates, & Mikeal, 2002) and others fail to report errors because of the effort required, lack of knowledge about the reporting system, fear of retribution from administration, loss of peer respect, or even loss of their job (Almutary & Lewis, 2012; Hajibabaei et al., 2014; Hartnell, MacKinnon, Sketris, & Fleming, 2012; Haw, Stubbs, & Dickens, 2014; Oshikoya et al., 2013). Without accurate data, it is unlikely that effective changes can be made to improve patient safety.

Nurses and medication management have been studied extensively because this is a key health system/patient interface. Some nurse-related issues have already been identified as impacting errors, including level of experience (Fasolino & Snyder, 2012), knowledge of pharmacology (Pazokian, Tafreshi, & Rassouli, 2014), and use of safe practices (Sahay, Hutchinson, & East, 2015). A number of studies have examined nurse perceptions of the causes of medication errors using a questionnaire with results often reflecting a need for a more supportive environment, decreased workload, improved packaging of medications, and technology that is more user-friendly (Mrayyan & Al-Atiyyat, 2011). In contrast, Fasolino and Snyder (2012) found, based on data from questionnaires and an error reporting system, that while greater experience by the nurse lead to decreased errors, the workplace environment was not strongly associated with medication error rates.

Using nurse interviews, Lawton, Carruthers, Gardner, Wright, and McEachan (2012) identified 10 latent errors (ward climate, human resources, local working environment, workload, routine procedures, bed management, team communication, written policies and procedures, supervision and leadership, and training) that they believed formed the basis of all medication errors. They proposed the use of this error set to evaluate organization-wide safety interventions and other error management strategies. They concluded that error management might be more effective if there was a focus on effective policies and procedures, working conditions, and staff education. These findings were supported by Volpe, Pinho, Stival, and de Oliveira Karnikowski (2014) who also emphasized the need to look beyond individual behaviors to system and environmental changes that will create safety barriers to prevent errors.

Although system change can be an important factor in improving patient safety related to medication management in our health system, the human factor in the process will not be removed anytime in the foreseeable future. One way to ensure that nurses are not having a negative impact on patient safety related to medication management is to validate that they are being prepared adequately for their role. Unfortunately, one of the biggest gaps in the literature relates to how nurses are prepared to manage medications safely. There are a limited number of studies that have looked at error rates and the impact of supervision on student error rates (Reid-Searl & Happell, 2012; Sears, Goldsworthy, & Goodman, 2010) and a few additional studies that investigated student knowledge of pharmacology, psychomotor skills, and teaching strategies to achieve basic medication administration competency, e.g., didactic content, simulation, quizzes, and

case studies (Ferguson, Delaney, & Hardy, 2014; Pauly-O'Neill & Prion, 2013; Whitehair, Provost, & Hurley, 2014). When discussed at all, medication safety or errors are generally related to following the “5-rights” of medication administration and correct use of specific technology. With the exception of a few simulation studies, there is little in the literature that addresses evaluation of teaching prelicensure nursing students (Aggar & Dawson, 2014; Amster, Marquard, Henneman, & Fisher, 2015; Ferguson et al., 2014; Pauly-O'Neill & Prion, 2013; Sears et al., 2010) or workplace orientation (Beyea, von Reyn, & Slattery, 2007; Kennedy, Nichols, Halamek, & Arafeh, 2012; Lamers, Janisse, Brown, Butler, & Watson, 2013) related to medication management. Other than the successful passing of the NCLEX-RN examination, there are no standardized methods or best practices for evaluating new graduate cognitive or psychomotor competencies in medication management (Gonzales, 2012; Spector, 2015).

Additional research is needed to identify the most effective strategies for teaching medication management in prelicensure nursing programs. Research is also needed to address efficient and effective ways to ensure medication management competency before new graduate RNs transition to independent nursing practice. Before either of these issues can be addressed there needs to be a clear understanding of what is currently taking place in nursing education and workplace orientation programs related to medication management. An important element in framing the effectiveness of what is taking place in current programs is to find out from new nurses what their perceptions are of medication error causes, error reporting, and the effectiveness of the education and orientation programs they have completed. Although recall by new graduates of content

and activities they experienced in their education and orientation programs may differ from the content and activities the programs report were provided, the nurses' accounts do provide an indication of the impact of those experiences on their practice.

In an effort to address the knowledge gap, as well as to improve patient safety and quality care, this research study explored the perspectives of new graduate RNs working in an acute care setting concerning medication errors, and their educational experiences related to medication management. It also identified current practices related to medication management education and hospital workplace orientation.

Purpose

The purpose of this study was to identify new graduate RN perceptions about medication error causes, associated behaviors, and error prevention education, as well as how new graduate RNs were being prepared for safe medication management during prelicensure nursing education, and workplace orientations.

Theoretical Framework

The theoretical framework that provides structure to this study is the theory of situated cognition. This theory posits that learning is more than an internal cognitive process, and that external factors play a key role in learning and the ability of a person to apply what they have learned in a given context or situation (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Smith & Semin, 2007). The theory of situated cognition is particularly applicable to the issue of medication management because the concepts within the theory closely align with regular activities in health care practice and education, and the findings in the literature related to medication errors. The theory is

based in cognitive science and the relationships among the various concepts relate to the complexities in nursing practice and help clarify some of the interactions that may be important in understanding why little progress has been made in error reduction.

Theoretical Concepts

The concepts within the theory are community, tools, activity, context, and situated (Brown et al., 1989; Lave & Wenger, 1991; Paige & Daley, 2009; Stein, 1998; A. L. Wilson, 1993). Community refers to the social environment and relationships in which a person functions. A person is believed to work within a “community of practice.” Medication management is impacted by community when the behaviors or information processing of health professionals and/or patients are affected by the organization’s culture, relationship patterns, and communications.

Tools are the items that are used as part of daily activities. These include physical artifacts, as well as prior knowledge and technology (Brown et al., 1989). The concept of tools is very important in understanding the impact of practice changes related to medication management. With the explosion of technology in health care, there are many new tools that health care workers are expected to integrate into their practice. To do this safely and effectively they need knowledge of how the tools impact the care they are giving and safety issues that might arise from their use. Because prior knowledge is a key tool in safe practice, it is also important that the educational systems effectively prepare new health care workers with an adequate knowledge foundation for safe practice.

The concept of activity refers to an individual's actions within a particular context (Brown et al., 1989). This concept is important to both practice and educational settings. To achieve the best performance or learning experience the activity should be “authentic” or based on real-world actions that the person is expected to carry out or learn. When considering medication management, an RN from the operating room might have difficulty successfully carrying out medication administration on a nursing unit, not because the nurse did not understand the basics of medication administration, but because the activity he or she was asked to perform was not an “authentic” or real-world activity for his or her normal practice. This also applies to education when students are taught to document medications on paper charts and use books for references in a lab, but at the same time they are expected to provide care in a hospital clinical using an electronic medication administration record, bar-code scanner, and electronic references in the EHR. If students build a cognitive framework without any “authentic” activities to practice what they know, they will find transitioning what they know to the clinical setting much more difficult.

The context of practice gives structure to all the previously discussed concepts: community, tools, and activity (Brown et al., 1989). It is the environment in which the community is placed, the tools are used, and the activities take place. The operating room nurse described earlier would have difficulty safely administering medications on an unfamiliar nursing unit not only because the activity he or she was asked to perform was not “authentic” for him or her, but the context in which he or she was expected to function was totally different from his or her usual intraoperative environment.

The overarching concept of being situated encompasses the fact that learning, and the subsequent application of that learning, are dependent on a replication of the complexity and ambiguity of the real world. Situated learning experiences occur through an individual's participation in the process within a relevant community, using similar tools, and authentic activities that are placed in a context or environment that is realistic for where the learning will be applied. Cognition is believed to be impacted by an individual's participation and situated in context.

Application of Theoretical Concepts to Education and Orientation

The theory of situated cognition can be very helpful in understanding ways for students to learn safe and effective medication management in an educational setting, as well as whether graduate nurses are able to transfer their knowledge and skills to real-world clinical practice. There is significant concern about whether safe care is being provided in our health care facilities, and medication management is one area of specific concern. More than one and a half million people are injured and billions of dollars are spent on additional medical treatment every year just because of medication errors (Aspden et al., 2007). There are concerns that educational organizations have not been able to keep up with resources to match the explosion of patient care technology that has been integrated into practice in the last few years. If nurses are being taught how to administer medications using outdated tools and in artificial settings outside of the context where they will be expected to practice, then they will not have adequate knowledge and skills to safely practice in the current health care arena upon graduation. Even more concerning is if these same students are learning in an obsolete context in the

classroom or skills lab one day, yet are expected to perform in a very different way the next day in a real clinical location.

Unfortunately, because there is very limited information in the literature about teaching medication administration, with the exception of medication calculation (Harner-Britner et al., 2006; Pauly-O'Neill & Prion, 2013; Røykenes & Larsen, 2010; Wright, 2005), it is not known what current education practices are or what they should be. The impact of technology integration on current education practices is also not known due to limited empirical data (Collins, Graves, Gullette, & Edwards, 2010; Greenfield, 2007; Schneidereith, 2015). Fortunately, the theory of situated cognition is useful as a model to evaluate whether we are teaching in a situated fashion, and identifying the components that would be needed to do so in an authentic way to match current practice. This will allow students to be better prepared to function effectively and safely in the clinical community of practice. Although this will be a good start toward improving medication administration teaching, it still leaves unanswered the bigger educational question of what is the right balance of knowledge that can effectively be transferred from the classroom setting and what is learned best through situated experiences.

The theory of situated cognition and its concepts will be discussed in greater detail in Chapter 2, with an expansion on the literature associated with each concept. In general, the theory reveals that it is not enough to learn the facts about a process, or even build a cognitive framework of the actions needed. Without an opportunity to engage in “authentic” activities, using realistic tools, in a community and context that replicates where the actions are expected to be performed in the future, a person will be seriously

challenged to effectively carry out the task they have been given, for example, to safely prepare, administer, or monitor medications.

Specific Aims

The following specific aims and research questions were addressed:

1. Identify new graduate RN perceptions about medication error causes, identification, and reporting.

Q1: What are new graduate RN perceptions about causes of medication errors?

Q2: What do new graduate RNs identify as a medication error?

Q3: What medication errors do new graduate RNs believe should be reported to the patient's physician?

Q4: What medication errors do new graduate RNs believe should be reported on an incident report?

Q5: What are new graduate RN perceptions about reporting medication errors?

Q6: Do new graduate RN perceptions of medication errors differ based on demographic characteristics?

2. Examine prelicensure nursing education program experiences that new graduate RNs report were effective in preparing them to safely manage medications and what additional experiences would have made them better prepared.

Q7: What do new graduate RNs report were the courses, teaching strategies, activities, or equipment used in their prelicensure nursing programs that effectively prepared them to safely manage medications (prepare, administer, and monitor)?

Q8: What do new graduate RNs think could have been done differently in their nursing education program to better prepare them to safely manage medications?

Q9: What do new graduate RNs report were the review topics, teaching strategies, activities, or equipment used in their workplace orientation that effectively prepared them to safely manage medications (prepare, administer, and monitor)?

Q10: What do new graduate RNs think could have been done differently in their workplace orientation to better prepare them to safely manage medications?

Q11: Do nurse-reported effective preparation experiences differ based on demographic characteristics?

3. Describe how new graduate RNs are being prepared to safely administer medications in prelicensure programs in NC.

Q12: Where in the nursing curriculum is new medication management content most frequently taught?

Q13: What teaching strategies are most commonly used to teach safe medication management?

Q14: What activities and equipment are most frequently used to teach safe medication management?

Q15: How do the courses, teaching strategies, activities, and equipment used to teach medication management in nursing programs compare to the effective preparation experiences reported by new graduate RNs?

4. Describe how new graduate RN workplace orientation ensures competency to safely manage medications.

Q16: What review topics, teaching strategies, activities, or equipment are used during new graduate RN workplace orientation to review safe medication management?

Q17: How are new graduate RNs evaluated to determine medication management competency during workplace orientation?

Q18: How do the review topics, teaching strategies, activities, and equipment used to review safe medication management during workplace orientation programs compare to the effective orientation experiences reported by new graduate RNs?

Definitions

For the purposes of this study, the following definitions were used:

1. Registered nurse (RN) – a person who has completed an RN education program, passed the National Council Licensure Examination for RNs (NCLEX-RN), and is licensed to practice nursing in one of the states or territories of the US. In this document, the term nurse refers to an RN, unless otherwise specified.
2. Pre-licensure nursing program – an education program designed to prepare individuals to practice nursing in North Carolina (NC) as described in the Nursing Practice Act (Nursing Practice Act, 1999) and approved by the NC Board of Nursing (2016a). This study included all levels of nurse education programs that prepare students

to sit for the NCLEX-RN examination and initial licensure as an RN: diploma, associate degree, and baccalaureate degree.

3. New graduate nurse – a nurse who is within their first 12 months of practice as an RN.

4. Medication management – a combination of the processes of prescribing, dispensing, preparing, administering, or monitoring medications (Aspden et al., 2007), and the clinical decision-making related to these processes. These processes are carried out by various health care team members including physicians, pharmacists, advanced practice nurses, physician assistants, and nurses. This study focused on the steps of preparing, administering, and monitoring, which are most frequently carried out by a nurse in the acute care setting. Despite a lack of evidence, nurses are traditionally taught to follow the “5-rights” of safe medication management: right drug, right dose, right time, right route, and right patient (Hughes & Blegen, 2008). A sixth right of “right documentation” is often added (Lilley, Collins, Harrington, & Snyder, 2011), but even more important to medication error prevention is for nurses to use their knowledge and clinical judgment to ensure a medication is given for the right reason.

5. Medication error – the definition recommended for researchers by the NCC MERP (2016) and used by the FDA is:

A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use. (para. 1).

6. Acute care – a health care setting where a person receives concentrated treatment for an illness or injury. Acute care settings include hospital inpatient units (short and long-term), emergency departments, operating rooms, Post Anesthesia Care Units (Recovery Room), outpatient surgical centers, and outpatient procedure units.

7. Workplace orientation – the process of orienting a new employee to the organization and the requirements of their job. Orientation includes information about the organization's mission, vision, policies, and procedures. In addition to the general organizational information provided to all new employees, new nurses also receive information related to their role as a nurse which may include a review of didactic clinical information and skills, verification of clinical competence, and a period of mentored practice with a nurse preceptor.

8. Health care provider – although any health care worker who participates in the care of patients could be considered a provider, in this study a narrower definition was used and the term, provider, refers to physicians, advanced practice RNs with prescribing privileges (primarily nurse practitioners), and physician assistants.

9. Incident report – the account of an event submitted in writing or electronically to an error reporting system or designated individual that details an occurrence that deviated from organizational policies and/or procedures, or is designated a “reportable event.”

10. Learning experiences – any activity that is intended to positively change an individual’s knowledge, skills, or attitudes related to a topic. These experiences can occur in a variety of locations, including classrooms, laboratories, clinical agencies, or community locations, and may involve a variety of teaching strategies, activities, and equipment.

11. Effective learning experiences – a learning experience is identified as effective based on the self-report of new graduate RNs according to whether they considered the experience provided effective preparation to safely manage medications.

Assumptions

Medication management is a complex process that involves multiple people, and is impacted by organizations and larger systems (Carayon et al., 2014). One of the primary assumptions of this study is that the performance of the nurse related to medication management can have a significant and clinically meaningful impact on error reduction.

It is also assumed that all new graduate RNs who successfully pass the NCLEX-RN licensure examination have demonstrated a minimal level of competence as a generalist nurse. If this is the case, because it is known that nurses make medication errors, then, assuming there are no system issues or broken processes, a suspicion arises that there must be something about their education or workplace orientation experiences

that is not adequately preparing them for safe practice or being identified by the NCLEX-RN examination.

The medication error definition recommended by NCC MERP (2016) was used for this study. Because the findings in the literature have been based on a variety of definitions, it was assumed that the definition used for this study was broad enough to create a meaningful relationship with previous findings.

The data collection surveys were distributed electronically, which could have limited a respondent's capability and willingness to participate. Given the current ubiquitous use of computers in education programs, health care, and the personal lives of Americans, it was assumed that an electronic survey would not be a significant obstacle to responses by new graduate nurses, education program faculty, or staff development staff, or cause a significant response bias.

Summary

Medication errors are an ongoing, serious problem in the US health care system, as well as systems throughout the world. As identified by the NCC MERP, there are many causes and factors that contribute to the occurrence of a medication error. Some of these causes will not be overcome until administrative changes are made within organizations and cultural changes occur within the healthcare system. Because "nurses are crucial in preventing medication errors" as well as other adverse events (Institute of Medicine, 2011, p. 3), the lack of literature related to best practices or effective strategies for prelicensure RN education and workplace orientation related to medication

administration safety is disturbing and fails to inform educators on ways to effectively prepare their students.

Therefore, this study addressed the gap in the literature by surveying new graduate RNs, nursing schools, and hospital staff development departments in one state in the US to determine nurse perceptions about medication error causes, associated behaviors and existing prevention education, as well as current strategies used in nursing education and workplace orientation programs to ensure safe medication management by new graduates. This information will be used to inform curriculum development in prelicensure nursing education and new graduate workplace orientation programs.

CHAPTER II

LITERATURE REVIEW

With the widespread changes occurring in the United States (US) health care system (American Recovery and Reinvestment Act, 2009; Benner, Sutphen, Leonard, & Day, 2010; Gialanella, 2012; US Department of Health and Human Services, 2015) it is critical that new nurses are adequately prepared to successfully transition into a complex, fast-paced, and technologically intense practice setting upon graduation. New nurses must not only be concerned about accurately applying their own knowledge and skills, but they must learn to successfully interface with the complex practice environment to provide safe care. This can be a challenge in a health system with a longstanding problem of high error rates. The continuing failure of the US health system to make significant improvement in health care errors rates (Aspden et al., 2007) highlights patient safety as an area in need of additional and innovative attention. When focusing specifically on medication errors, numerous studies have identified what errors are being made (Berdot et al., 2012; Cebeci et al., 2015; Küng et al., 2013), additional studies have clarified a variety of causes for the errors (Härkänen, Ahonen, Kervinen, Turunen, & Vehviläinen-Julkunen, 2015; Keers et al., 2015; Pham et al., 2011), and several models have been presented to assist in understanding why the errors occur (C.-C. Hung, Lee, Tsai, Tseng, & Chang, 2013; Nelms, Jones, & Treiber, 2011; Sitterding, Ebright,

Broome, Patterson, & Wuchner, 2014). What has not been brought to light is an effective, integrated way to prepare health care providers to prevent errors. Dr. Carol Durham, a national leader in quality and safety education for nurses, identified a key question that needs to be asked about health care provider education if the US health system is going to become safer for patients, “What are we doing, that we are doing the same, and expecting a different outcome?” (C. F. Durham, Atz, & Wilkinson, 2016). Rather than focusing on fixing the results of errors, it is time to utilize what is known about medication errors to ensure caregivers are prepared to practice so the errors never occur.

The sheer volume of studies about medication errors presents a daunting task to create meaning from all the information. Because history shows that progress on curbing medication errors has been inadequate (Aspden et al., 2007), a new perspective is needed to apply our current knowledge to address the situation. Based on this author’s experience, there appears to be a “disconnect” between how prelicensure nursing students are educated in academic settings and the knowledge and skills they are expected to demonstrate in clinical settings. Is this lack of congruence between education and practice one of the reasons for the ongoing high medication error rates? A major challenge in answering this question is the lack of data related to best practices or effective strategies for teaching medication management. A framework is needed to create understanding from the findings in the literature related to medication errors to identify what we know, what is effective in decreasing medication errors, and what gaps

remain to be filled. The theory of situated cognition can provide a relevant framework to understand what is known and a structure to carry out needed research.

This chapter provides background on the theory of situated cognition, presents the concepts associated with the theory, and utilizes the theory's concepts of community, tools, activities, and context to organize and discuss the evidence cited in the literature related to medication error causes and contributing factors. A discussion of current medication management education is provided. This chapter also clarifies gaps in knowledge and actions that need to be taken to fill those gaps in an effort to reduce medication errors in the future.

Theoretical Framework

Situated Cognition Origins

Situated cognition (also referred to as situated learning) evolved from social cognitive theory (Bandura, 1986). This theory differs from most traditional cognitive theory in that it describes learning as not taking place solely within an individual's mind, but in association with external social experiences. It is believed that context structures learning and knowing (Brown et al., 1989; Lave & Wenger, 1991; Smith & Semin, 2007). This theory also has ties to the adult learning theory described by Dewey (1938), Lindeman (1926) and Knowles (1980). The work of Knowles is particularly relevant because he emphasized the importance of making learning meaningful to adult learners by linking it to their everyday lives.

When it was noted that the real world observations of behaviors did not match the current theory of cognition, situated cognition was developed inductively based on the need to find a better explanation for how thinking and learning took place (Lave, 1988; Lave & Wenger, 1991; A. L. Wilson, 1993). According to this theory, the combination of generalized internal cognitive structure development and external interactions with others results in learning. Through interactions with others, an individual can progress from a novice in a “community of practice” to a full member (Lave & Wenger, 1991).

In the following section the key concepts of situated cognition (community, tool, activity, context, and situated) are defined and associated relational statements presented. These concepts provide a framework for the later discussion of the literature related to medication error causes and contributing factors.

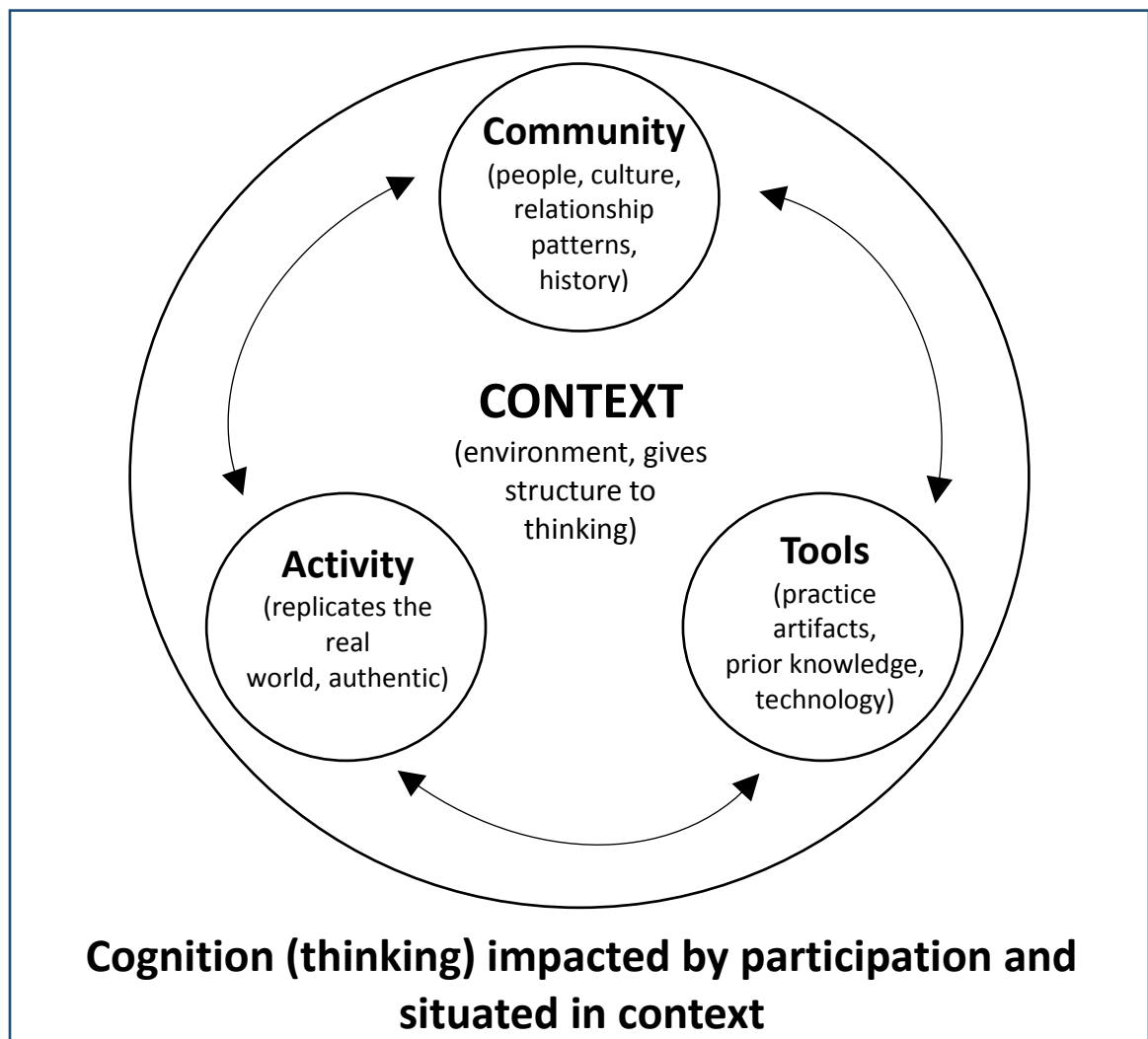
Situated Cognition Major Concepts

The complex relationships among the concepts of this theory create a significant challenge to achieving a thorough understanding of the theory. This may be one of the reasons there are few graphical representations of the theory in the literature. No pictorial representation of the theory was provided in the early writings about the theory (Brown et al., 1989; Lave, Murtaugh, & de la Rocha, 1984; Lave & Wenger, 1991), so the model below was developed by the author and is derived from the theory concept descriptions from Brown, Collins, & Duguid, (1989) and Lave and Wenger (1991).

The major concepts identified in the situated cognition literature are community, tools, activity, context, and situated (Brown et al., 1989; Lave & Wenger, 1991; Paige & Daley, 2009; Stein, 1998; A. L. Wilson, 1993). These concepts are defined below.

Figure 1

Model of Situated Cognition



Community refers to the social context in which thinking and learning takes place. This concept has also been identified as a “community of practice” and has a distinct culture (Brown et al., 1989). Individuals are said to join the community through a process of enculturation where learning and knowing involve becoming part of the community’s culture, not just acquiring content. A nurse who works in a hospital participates in multiple communities. The nurse is a member of the staff of an assigned nursing unit, which has a nursing-focused culture, and may also be a member of a hospital committee that is made up of different people with a different purpose and culture. The nurse’s cognitive experiences will differ in the two separate communities.

Tools can be things such as prior knowledge, technology, or artifacts (Brown et al., 1989). They can be actual physical items, located or accessed in the environment, or information. They are said to be situationally provided and give structure to the cognitive processes of the individual. A nurse would have a great deal of difficulty learning how to give an injection safely if there was no opportunity to handle the medication, syringe, needle, or other items needed to perform the task. Similarly, he or she would not have as much chance of learning to use the needle and syringe safely without knowledge of anatomy and physiology.

Activities occur when an individual acts within or interacts with the context (Brown et al., 1989). Learning takes place when these activities are “authentic.” Authentic activities are socially interactive and require use of the actual cognitive processes needed to perform the task or process the information in a real-world situation.

If a new piece of equipment is being introduced into patient care on a hospital nursing unit, the nursing staff need to be trained in its use to provide safe care. According to situated cognition, asking the staff to read a pamphlet about the piece of equipment is not an effective way for them to learn about the equipment because it does not place their learning in a real-world context, provide relevant tools, or engage them in authentic activities. Conversely, providing an interactive computer program that allows the staff to manipulate the piece of equipment on the screen and practice operating it in realistic situations would lead to much greater understanding and safer use. The ideal situation would be to have the piece of equipment so that the staff could handle it and practice using it in their work environment. This would be the most effective in helping the staff process all the nuances of using the item within the culture and normal activities of their community of practice.

Context is the environment that an individual interacts with in their daily lives. All thinking and learning is believed to be situated in a particular context and it is said to give structure to learning. Context provides the underpinning for the concepts of community, tool, and activity. A hospital could be a context for a nurse. The nurse would respond in a particular way to things he or she experiences in the hospital setting, as compared to when exposed to a different environment.

To situate learning means to build experiences for the learner that replicate the complexity and ambiguity found in the real world. Elements of the community, tools, and activities, within a contextual environment, all interact to create situated experiences.

As stated earlier, one of the most challenging aspects of a thorough understanding of the theory of situated cognition is the complexity of the interactions among the theory's concepts. The following relational statements are provided to clarify the interactions of the theory's concepts:

- Situated cognition requires community, tools, activities, and a context.
- Context provides the foundation on which community, tools and activities interact.
- Context provides the social environment required for thinking and learning.
- Context and community determine the tools needed for learning.
- Tools are required for activities to take place.
- Situationally provided tools structure an adult's thinking.
- Activities are the ordinary practices of the community.

The theory is useful across a wide variety of disciplines, as seen by its use in fields as diverse as knowledge acquisition, expert computer systems and information technology (Compton, 2013; Robbin & Koball, 2001); organizational functioning (Elsbach, Barr, & Hargadon, 2005; Shattuck & Miller, 2006); marketing and consumer science (Dew, Grichnik, Mayer-Haug, Read, & Brinckmann, 2015; Schwarz, 2006); the aviation industry (Lintern, 1995; Nevile, 2006); and military mishap investigation (Shattuck & Miller, 2006); as well as the more traditional fields of psychology (Oyserman, Sorensen, Reber, & Chen, 2009; Wasner, Moeller, Fischer, & Nuerk, 2014); and education (Choi & Hannafin, 1995; Griffin & Griffin, 1996; D. W. L. Hung & Chen,

2001). Although the theory of situated cognition has only seen limited use in health care research, it has been utilized in a variety of settings. By far the largest number of studies have focused on education, and specifically the use of technology in education (Cope, Cuthbertson, & Stoddart, 2000; Paige & Daley, 2009; Rowe, Bozalek, & Frantz, 2013; Wideman et al., 2007; Woolley & Jarvis, 2007), but situated cognition has also been used as the framework for investigations related to professional continuing education (Manley, Titchen, & Hardy, 2009; Webster-Wright, 2009), clinical workplace skills (Curran et al., 2015; Pimmer, Pachler, & Genewein, 2013) and engagement of patients in care (Amico, 2011).

The literature demonstrates that the theory's overall premise that individual learning is situated has been supported (Goel, Johnson, Junglas, & Ives, 2010; Lave et al., 1984; Lintern, 1995; Paige & Daley, 2009; Szymanski & Morrell, 2009), but there is little empirical evidence that how thinking and learning occurs is represented by the concepts described in the theory. The predictive value of the theory is not known at this time because of this lack of empirical evidence. Despite this lack of evidence, the theory is still a valuable tool to study the complex interactions between education programs, practice requirements, and individual readiness for safe practice.

This study used all of the theory's concepts to describe new graduate registered nurse (RN) perceptions and knowledge related to medication management errors, and their prelicensure and workplace medication management education experiences. The concepts were also used to identify practices in prelicensure nursing programs and

hospital staff education programs that are used to develop competencies in medication management. To provide a foundation for this investigation, a review of current literature is presented using the concepts from the theory of situated cognition as an organizing framework.

Medication Management Literature

To evaluate the current state of knowledge related to medication errors and how medication error evidence is being used in education and workplace orientation, a literature search was conducted using several combinations of the following search terms and Boolean operators: medication administration, drug administration, errors, nurse, medication errors, medication errors by nurses, medication errors in nursing, drug errors by nurses, drug errors in nursing, drug administration errors by nurses, and drug administration errors in nursing. The PubMed and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were searched for peer reviewed, English language studies. Because of the large number of studies returned in the initial search (1158) a research librarian was consulted for recommendations on narrowing search terminology, and the search time period was narrowed to studies completed in the past 10 years. Because it was believed that technology could have a major impact on medication error reduction (Aspden et al., 2007), the period of 10 years was chosen to provide a broad enough sampling of the literature before and after the passing of the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 (American Recovery and Reinvestment Act, 2009). HITECH, part of the American

Recovery and Reinvestment Act of 2009, mandated demonstration of “meaningful use” of electronic health records (EHRs) by providers and health care organizations by 2015.

A total of 998 studies were identified since 2006, and this number was reduced to 701 after duplicates were removed. Articles were excluded if they were not peer reviewed, in English, and a report of original research with a primary focus on medication management by RNs in an acute care setting, or medication management instruction during prelicensure RN education or new graduate workplace orientation. All article abstracts were first screened against the exclusion criteria, and then a full text review was conducted on the remaining articles. After application of the exclusion criteria and full text review 109 studies remained and were included in this review. Because of the low number of articles related to medication management in nursing education and orientation, an additional focused search was conducted using combinations of the terms medication, error, orientation, and medication error, in an attempt to capture literature related to RN education and new graduate orientation. An additional 8 studies were added to the initial search, after a review of abstracts and application of the exclusion criteria. All the studies were reviewed again and categorized by their relationship to errors in medication management and organized in groups based on the concepts of the theory of situated cognition.

Medication Errors and Theoretical Concepts

Medication management is a complex process that involves multiple people and requires knowledge, skills, and sound clinical judgement (Jennings, Sandelowski, &

Mark, 2011; Lim & Honey, 2015; Manias, Aitken, & Dunning, 2004). To identify the changes that need to occur to prevent medication errors, it is important to first understand the interactions taking place. By using the theory of situated cognition as a framework to review the studies related to medication errors, it will become clear as to what is known about how individuals and the environment in which they are asked to function impact medication errors, and where there are knowledge gaps. The literature will be presented using these theoretical concepts: community, tool, activity, and context.

Community. By far the largest number of medication error studies have focused on issues related to community, accounting for 51 of the 109 medication error studies reviewed. The concept of community includes the culture of a group, the people within the group, and the relationships between the people, all of which are discussed separately below. When applied to medication management the culture of the practice community involves the behaviors, beliefs, and attitudes that are applied to the duties related to medications. People impact medication management through choosing to follow, or not follow, guidelines and safe practices, unavoidable human errors (human factors), and application of their individual knowledge and skills. Relationships are critical in medication management because they include interactions and communications between nurses and patients, among nurse coworkers, and between nurses and members of other professions who are part of the patient's care team. All facets of the concept of community play an important role in identifying safe medication management activities

and areas where changes need to occur to move health care from a posture of responding to medication errors into proactive prevention of errors.

Culture. Failure to report an error is one of the most frequent culture-related behaviors in medication management. Up to 95% of the incidents of failure to report have been attributed to fear of reprimand by organizational management or loss of respect by coworkers (Almutary & Lewis, 2012; Bayazidi, Zarezadeh, Zamanzadeh, & Parvan, 2012; Chiang, Lin, Hsu, & Ma, 2010; Gladstone, 1995; C.-C. Hung, Chu, Lee, & Hsiao, 2016; Lin & Ma, 2009; Mrayyan, 2012; Osborne, Blais, & Hayes, 1999; Patrician & Brosch, 2009; You et al., 2015). Both the beliefs of the individual nurse and the organizational culture play roles in failure to report.

Osborne, Blais, & Hayes (1999), in a descriptive, comparative study using the modified Gladstone scale, identified nurse perceptions of error causes and reporting practices. Of the 57 nurses who participated from a large community medical center in Florida, 86% stated that they believed nurses did not report errors because of fear, and they personally had not reported an error because of being afraid of repercussions. Additional findings indicated that almost half of the nurses (43.9%) thought that only 25% of medication errors were reported on incident reports and 73.7% thought that medication errors were reported less than 50% of the time. Although the study used a small convenience sample of nurses working in medical-surgical areas, it provided clear evidence supporting the problems highlighted in *To Err is Human* (Kohn et al., 2000) which was published the following year.

Bayazidi, Zarezadeh, Zamanzadeh, and Parvan (2012) obtained findings similar to Osborne et al. (1999) when they explored the barriers and facilitators of medication error reporting in a group of medical teaching hospitals in Iran. Questionnaires completed by 733 nurses disclosed that the nurses reported “far less” errors than they actually committed, including that they reported less than half of their errors resulting in patient harm. The key barriers to reporting centered on concerns about the organization’s response to an error: blaming the individual rather than considering system impact and fear of punishment. The greatest facilitators were having an anonymous reporting system, understanding the benefits of reporting errors, and reducing the atmosphere of fear related to reporting errors. Based on the ethical principles of non-maleficance and beneficence, the authors pointed out that it is the nurse’s moral and ethical duty to do no harm and to have the welfare of the patient in mind when providing care. Despite the fact that lower medication error rates may be desired by managers and administrators, it is in the patient’s best interest to have a mechanism to systematically collect error data and a safe environment for error reporting so that error causes can be addressed and patient safety improved.

In a qualitative study by Haw, Stubbs, & Dickens (2014), 50 psychiatric nurses at a tertiary care, charity hospital in the United Kingdom (UK) were interviewed to discover whether they would report a medication error made by a colleague (n=26) or their own near miss (n=30). The interviews used one medication error vignette and one near miss vignette with standardized questions and cues to elicit the fullest response. Less than half

of the nurses reported that they would report an error made by a colleague (48%) or their own near miss (40%). The reasons given for not reporting an error by a colleague fell into four main themes: *excusing* the other person's behavior (90%), *knowledge* about the reporting system or what constituted an error (46%), *fear* of causing conflict with co-workers (27%), and *burden* of reporting (12%). Reasons for not reporting a near miss resulted in the same four themes, but with a very different emphasis: *fear* of loss of peer respect or disciplinary/legal action (60%), *burden* of reporting (50%), *knowledge* of the reporting system or definition of a near miss (37%), and *excusing* behavior (17%). It was particularly interesting that the focus of the responses related to fear were very different when the nurses were asked about someone else's behavior rather than their own, especially in light of the fact that the researchers made it very clear in their report that it was very unlikely that disciplinary action would be taken against a nurse who made a mistake because "the organizational aim is to encourage a no-blame culture regarding errors and their reporting, most errors being multi-factorial in cause and rooted in system failures." (Haw et al., 2014, p. 799). This study is unique in separating nurses' responses to identification of an error from having an actual near miss experience themselves. Understanding that nurses respond differently in these situations highlights the complexity involved with identifying errors and error rates, and effective methods to prevent errors.

The presence or absence of a culture of safety has been noted as another factor impacting error reporting (Güneş, Gürlek, & Sönmez, 2014; Kagan & Barnoy, 2008;

Moody, Pesut, & Harrington, 2006). In order to provide safe, high-quality, and cost effective care, healthcare workers need to incorporate a culture of safety in their work behaviors (Moody et al., 2006). “Safety culture is a performance shaping factor which guides the many discretionary behaviors of healthcare professionals toward viewing patient safety as one of their highest priorities” (Nieva & Sorra, 2003, p. 17). Unlike the culture of “blame and shame” that has long existed in health care, a culture of safety acknowledges that errors are inevitable and seeks to identify and intervene in the latent threats rather than punish health care workers after a mistake has been made. A cultural evolution is needed in the workplace to facilitate error reporting, thus permitting the error events to be investigated and learned from so they can be prevented in the future or their impact can be mitigated (Nieva & Sorra, 2003).

In a descriptive, correlational study by Moody, Pesut, and Harrington (2006) 158 nurses (RNs (83%) and LPNs) from six medical-surgical units in two metropolitan hospitals were surveyed over a 6-month period to investigate the human behavioral and organizational variables that impacted the development of a safety culture. In addition to the surveys, nurse productivity and medication error data were extracted from the nursing management automated records for the six months prior to the survey data collection period. Moody et al. (2006) described the nurses’ willingness to report an error as “the hallmark of safety culture” (p. 202). They found that error reporting positively correlated with

(1) organizational learning ($r = 0.209$; $\alpha = 0.01$), (2) overall perceptions of safety ($r = 0.173$; $\alpha = 0.01$), (3) supervisor/manager actions and expectations promoting safety ($r = 0.233$; $\alpha = 0.01$), (4) consistent feedback and communication about error ($r = 0.349$; $\alpha = 0.01$), and (5) openness of communication ($r = 0.270$; $\alpha = 0.01$) on the nursing units (p. 202).

Error reporting was found to increase the more the staff nurses perceived support for patient safety from nursing administration, but error rates rose the higher the level of nurse productivity (fewer nurses taking care of more patients).

Güneş, Gürlek, and Sönmez (2014), in a study of the factors contributing to medication errors by nurses in Turkey, highlighted the impact of not having a culture of safety. In a descriptive study to explore the types of errors that occurred, the factors that contributed to the errors, and error reporting, they surveyed 243 nurses working in two state hospitals in Turkey. The most common causes of medication errors reported were administering a medication without a doctor's order (72%), administering a medication prepared by someone else (55.3%), and administering a medication to the wrong patient (24.7%). The factors that the nurses believed most frequently contributed to the errors were the need to write an order in place of a physician (70%), the physician giving a verbal order in a non-emergency situation (53.1%), an order not being written in time (46.9%), and no order being written (45.3%). Unlike in the US and some countries around the world, nurses in Turkey do not have prescriptive authority and administering a medication without a doctor's order can lead to legal and professional issues. Despite these consequences, according to the study authors, it is a cultural norm for nurses in

Turkey to administer medications without an order if a physician is not available, potentially leading to a myriad of patient safety issues such as over-prescribing, errors in prescribing, and misdiagnosis of patient conditions. Of the nurses who reported making a medication error in the previous six months, 66.7% of them stated they had not reported the error and almost one-third of them (29.6%) responded that they did not know how to report an error. The researchers remarked that one of the key challenges related to reducing medication errors was that “In Turkey ... a culture of patient safety has not been established, a system for reporting medical errors has not been set up, and errors are generally concealed” (Güneş et al., 2014, p. 301). Until progress is made toward the development of a culture of safety with error reporting, it is anticipated that it will be very difficult to achieve advancements in reducing medication errors through systematic identification and intervention in individual and system error causes.

Medication error self-reporting, the perceived incidence of medication errors, and factors that influenced error reporting, including a culture of safety, were investigated by Kagan and Barnoy (2008) in a descriptive, cross-sectional study. A convenience sample of 201 Israeli nurses in advanced training courses or a bachelor's completion program were surveyed using a researcher-constructed questionnaire. The researchers found that 95% of the nurses reported encountering at least one medication error in the preceding year, and 91% stated that they had cared for patients who had received the wrong medication from another health care worker. Only 26% of the nurses believed that all of the errors made were reported and less than half (46%) responded that they always

reported their own medication errors. A little more than half (54%) of the participants stated they reported errors they discovered made by others to administration, but not all the time. A negative correlation was found between the number of errors discovered and the number reported, but the more positive the nurse perception of error reporting and administrative response to errors the greater the level of error self-reporting. Viewed in a different way,

The more ward nurse managers and staff nurses tended to cover up the error, that is, dealing with the error themselves without reporting to a higher authority, the less frequently were errors self-reported. Nurse managers play an important role in forming the ward's norms on dealing with errors (Kagan & Barnoy, 2008, p. 357).

At the time of the report there was no centralized reporting system for medication error or standardized nomenclature for patient safety events in Israel, and there was a residual culture of blame and punitive response when errors were identified, all of which impacted the participant's ability and willingness to report errors. The authors reported that there were notable differences in how organizations identified and addressed medication errors, with one of the key factors being differences in organizational culture especially related to patient safety leadership. They concluded that to achieve change a national policy was needed for error reporting and organizations needed to develop a safety culture that supported reporting and improvement in a non-punitive environment.

People. Although many people take part in the medication management processes, nurses are at high risk for errors, spending 19% to 27% of their work time

administering medications (Keohane et al., 2008; Westbrook, Duffield, Li, & Creswick, 2011). Nurses also play a crucial role in medication safety because they are often the last person in the process who can intercept an error before it reaches a patient (Aspden et al., 2007; Flynn, Liang, Dickson, Xie, & Suh, 2012; Samaranayake, Cheung, Chui, & Cheung, 2013). Failure to follow policies and guidelines is one of the most frequently reported ways that individuals impact medication errors (Abbasinazari, Talasaz, Mousavi, & Zare-Toranposhti, 2013; Alsulami, Choonara, & Conroy, 2014; Donaldson, Aydin, Fridman, et al., 2014; Dougherty, Sque, & Crouch, 2012; Gunningberg, Pöder, Donaldson, & Leo Swenne, 2014; Jones & Treiber, 2010; J. Kim & Bates, 2013; Ulas et al., 2015; Xu, Li, Ye, & Lu, 2014). These directives include organizational policies associated with a job, e.g., standardized medication administration times, and standards of professional nursing practice, e.g., adherence to safe practices, such as following the “5-rights” of medication administration. Other ways that people impact medication management are through unavoidable human errors (human factors) (Sanghera, Franklin, & Dhillon, 2007; Ulanimo, O’Leary-Kelley, & Connolly, 2007), and application of their individual knowledge and skills (Daouphars et al., 2012; Smeulers, Onderwater, van Zwieten, & Vermeulen, 2014; Treiber & Jones, 2010; Unver, Tastan, & Akbayrak, 2012).

Ulas et al. (2015) described the devastating effects that can occur when oncology nurses fail to follow policies and procedures related to administration of chemotherapy. In a study to investigate medication errors during chemotherapy and their underlying factors, 206 nurses on 18 adult chemotherapy units were surveyed using face-to-face

interviews. The most common nursing related errors reported were not following the correct administration sequence (50.5%) and not following the correct infusion time for the chemotherapy agents (39.7%), which was also identified as the most common average error per month (4.1 times/month, Range 1-20). The top three contributing factors, according to the nurses, were high work load (49.7%), insufficient staff (36.5%), and stress/tiredness and burnout (25.6%). There is always the potential for increased morbidity, mortality and length of hospitalization when a medication error is made and this problem is compounded with chemotherapy agents. The findings would have been more informative if they had not been based on nurse perceptions of error occurrence because self-reports have been shown to be less accurate than the “gold standard” of direct observation of practice (Meyer-Masseti et al., 2011; Westbrook et al., 2015), but the results still highlight the importance of knowing and following policies and procedures to reduce errors.

Xu, Li, Ye, and Lu (2014) used a quasi-experimental study design to investigate the impact of a 5-point medication management strategy on

rate of accurate compliance with medication policies and procedures; success rate of medication administration procedures; frequency of ME [medication errors]; rate of nurse-initiated ME reports; rate of inpatients' satisfaction with medication management; and the number of complaints related to nursing medication administration (p. 288).

The 5-point medication management strategy included nurse training to improve knowledge and skills related to medication safety; optimization of medication policies;

refining drug management and storage practices; improving intravenous medication processes; and enhancing medication administration processes, including implementing a medication error reporting system, expanding quality control activities and improving medication hand-off processes. The study was carried out in 31 units in a large teaching hospital in China over a four-year period that included management strategy development and a two-year implementation period. After the implementation of the 5-point strategy, the rate of compliance with policies and procedures increased from 86.7% to 97.5%, successful medication procedure/administration rate increased from 94.0% to 96.8%, the number of medication error reports increased from 77.1% to 98.3%, patient satisfaction with medication management improved from 92.1% to 98.3%. These results demonstrated that implementation of the comprehensive 5-point management strategy was effective in improving nurse awareness and skill in safe medication administration practices, and resulted in an increase in policy compliance, reduction in errors, and increase in patient satisfaction.

Donaldson, Aydin, Fridman, and Foley (2014) presented findings from a cross-sectional, convenience sample of data from the ongoing Collaborative Alliance for Nursing Outcomes (CALNOC) benchmarking registry which includes more than 15 years of data on nurse sensitive measures from 1600 units and 48 million patient days. Data gathered by CALNOC includes process measures on medication administration accuracy, and outcome measures on safe practices for medication administration accuracy and error rates (Collaborative Alliance for Nursing Outcomes, 2016). The sample reported in this

study included direct observation data from 333 observation studies on 157 adult acute care units in 43 hospitals and included 33,425 medication doses. The aims of the study were to describe the naïve observation process used by CALNOC, evaluate nurse adherence to six medication safe practices, assess the prevalence of medication administration errors in adult acute care units, and examine the relationship between deviation from safe practices and medication errors by nurses in the acute care units. The “5-rights” of medication administration were operationalized by CALNOC in the following six medication safe practices for nurse observation data collection:

1. compared medication with MA [medication administration] record (MAR),
 2. minimized distraction or interruption during medication preparation or administration,
 3. ensured medication is labeled throughout the process from preparation to administration,
 4. checked two forms of patient identification prior to administration of medication,
 5. explained medication to patient or family as appropriate,
 6. charted/documented MA immediately after completion
- (Donaldson, Aydin, Fridman, et al., 2014, p. 60)

In addition to the six safe practices, the nurse observer compared the patient record to observed practice to identify error occurrence based on these 10 categories of possible error:

1. No error observed.
2. Unauthorized drug error: Administration of a dose never ordered for that patient.
3. Wrong dose error: Any dose of a drug (excluding an injectable drug) that contained the wrong number of dosage units (such as tablets) or is, in the judgment of the observer, more than 17% greater or less than the correct dosage.
4. Wrong form error: The administration of a drug dose in a different form than ordered by the prescriber when prescriber wrote for a specific dosage form.
5. Wrong route error: Medication administered to a patient using a different route than ordered.
6. Wrong technique error: Using an inappropriate procedure or improper technique in administration of a drug. Focus is on technique violations that can alter drug effect.
7. Extra dose error: Any dose given in excess of the total number of times authorized by physician order.
8. Omission error:
 - (a) Failure to give an ordered dose that appears on the MAR by the time the next dose is due. Patient refusals or drugs appropriately withheld are not considered omissions.
 - (b) Order found in the medical record that does not appear on the MAR.
9. Wrong time error: Administration of a dose more than 60 min before or after scheduled administration time. If food is involved in the order, the dose should be given within 30 min of scheduled time.
10. Drug not available error: Administration of a dose more than 60 min after scheduled administration time due to non-availability of the medication (Donaldson, Aydin, Fridman, et al., 2014, p. 60).

The observations included evaluation of whether the nurse followed common medication administration policies and safe practices. It was found that there was an overall rate of deviation from safe practices of 11.40% per encounter, and an overall medication administration error rate of 0.32%. The most common safe practice deviations were interruptions or distractions (22.89%), not explaining the medication to the patient (13.90%), failure to check two forms of identification (12.47%), and failure to document the medication administration immediately (10.68%). Lack of drug availability (0.76%)

and giving the wrong dose (0.45%) were the most common medication administration errors (Donaldson, Aydin, Fridman, et al., 2014).

The large size of the sample increases the potential generalizability of the results even though the data were extracted from a registry that was focused on process improvement by the contributing hospitals. Despite efforts to ensure interrater reliability, it was likely that some variability was introduced due to each facility managing which nurses were available for data collection. It was also discovered that variation in hospital policies and procedures related to wrong time and wrong technique confounded the results of these two errors and limited confidence in their results, and led to the researchers excluding these categories from further analysis in this study. Greater variation in results were found within unit data rather than between units or across hospitals. The authors suggested that this variation may have been a result of important microsystems functioning across shifts on a unit, such as the culture of safety or support system availability, which need further study. Because of mandated nurse-patient ratios in most CALNOC hospitals, variations in nurse staffing should have had minimal impact on the results. Ultimately, the findings confirm that following safe practices related to medication administration can reduce medication errors with an estimated 34 fewer errors for each time one safe practice deviation is avoided (Donaldson, Aydin, Fridman, et al., 2014).

In addition to failing to follow policies and procedures, medication errors also occur due to human errors such as mistakes, mental lapses, tiredness, or not using

knowledge effectively (Keers et al., 2015; Sanghera et al., 2007). Sanghera, Franklin, and Dhillon (2007) investigated the attitudes and beliefs of health care professionals related to medication errors in an intensive care unit (ICU) setting. The qualitative study was carried out in the ICU of a 1000-bed National Health Service Trust hospital in the UK. Potential participants were identified from medication errors reported on paper-based critical incident report forms, and errors noted by the intensive care pharmacist on his daily rounds in the unit. Due to a lower than expected number of written error reports, purposive sampling was also used from the pharmacist-identified errors to provide a broader range of error types. Both prescribing and administration errors were included in the study. An attempt was made to interview the staff involved in an error within 96 hours of its occurrence to improve recall accuracy. Semi-structured interviews with 13 staff members related to 12 different errors were carried out to identify the cause of the error, why the error was or was not reported, and general beliefs about medication errors and their reporting. The interviews were transcribed verbatim and analyzed using Reason's model of accident causation (Reason, 1990). Primary active failures were identified for 11 of the errors and included four slips, one lapse, five mistakes, and one violation. All the slips were attributed to not paying enough attention, and the lapse was reported as due to memory failure. The mistakes were all rule-based and associated with a lack of knowledge or application of knowledge related to safe administration of the medications. The single violation failure was associated with a nurse administering a medication without an order and the individual reported this was common practice. Error

producing conditions were also found to contribute to error occurrence. The most frequent condition was work-related (six reports), but team factors, individual factors, and task factors also played a role. One finding that was unique to this setting was the fact that the pharmacist provided a defense against errors through his daily review of order and participation in multidisciplinary rounds. Ten of the 13 errors were intercepted by the pharmacist with nurses identifying and addressing the other three errors. Although human factors play a significant role in medication errors, as shown in this study, they do not occur in isolation and interventions to reduce errors need to include methods to mitigate the impact of both human factors and error-producing conditions that may exacerbate them before an error reaches a patient.

In a more recent study of human errors in medication management, which also used Reason's (1990) model of accident causation, Keers, Williams, Cooke, and Ashcroft (2015) carried out a qualitative study using interviews to investigate the causes of intravenous medication administration errors in two National Health Service hospitals in England. Purposive sampling was used to recruit 20 nurses working in a variety of inpatient settings. Semi-structured interviews were conducted using the critical incident technique in which the participants were asked to discuss what they believed were the causes of the intravenous medication administration errors in which they had been directly involved. Themes were identified using the Framework approach to analyze the interview transcripts, and the themes that emerged were categorized using Reason's model of accident causation. During the interviews with the 20 nurses, 21 medication

errors were discussed, and resulted in 23 active failures being identified. Mistakes accounted for eight of the active failures (five knowledge-based and three rule-based), seven failures were categorized as slips, four were lapses, and four were deliberate failures to follow policy. These active failures by the nurses were also compounded by error-producing conditions in the work environment. The authors described how the rich data obtained through use of the critical incident technique enabled them to identify the complex interactions between the nurses' behaviors and environment in which they worked. The study found that "hospital nurses' intravenous MAEs [medication administration errors] occur largely due to the error- and violation-provoking environment in which they work" (Keers et al., 2015, p. 6). These findings highlight the need for multifactorial interventions to error prevention rather than just focusing on the individual who made the error.

Relationships. Although reported less often than human factors, the impacts of the support level of workplace relationships and functioning of interdisciplinary teams on medication errors have been identified in several studies (Adhikari, Tocher, Smith, Corcoran, & MacArthur, 2014; Donaldson, Aydin, & Fridman, 2014; Flynn et al., 2012; Havens, Vasey, Gittell, & Lin, 2010; Kazaoka, Ohtsuka, Ueno, & Mori, 2007; Sahay et al., 2015). In an effort to "determine the relationships among characteristics of the nursing practice environment, nurse staffing levels, nurses' error interception practices, and rates of nonintercepted medication errors in acute care hospitals" (Flynn et al., 2012, p. 180), Flynn, Liang, Dickson, Xie, and Suh (2012) surveyed 686 nurses from 82

medical-surgical units in 14 acute care hospitals in the US. Data were also collected on the number of medication errors reported in the error-reporting system and the number of patient days per unit. These data were used to calculate a medication error rate per 1000 patient days for each unit. The number of RN hours per patient day was also calculated for each unit, and work environment data were collected using the Practice Environment Scale of the Nursing Work Index (PES-NWI). To identify the impact of technology on medication error rates, the nurses were asked to identify the medication management technology available in their practice settings. Interestingly, there was no association found between nurse staffing levels or technology used, e.g., computerized patient record, bar-coding, or computerized provider order entry, and medication error rates. A positive and significant relationship was found between a supportive practice environment and nurse error interception practices. In addition, the more nurses utilized interception practices the lower the rate of errors. This study demonstrated that a supportive practice environment can have a direct positive influence on the occurrence of medication errors.

Sahay, Hutchinson and East (2015) achieved similar findings as Flynn et al. (2012) in an online survey of 58 new nurse graduates in Australia which analyzed self-reported errors, safe medication practices and available workplace support and relationships. It was found that the lower the amount of supportive workplace relationships, the higher the number of errors reported and the more degradation seen in safe practices. Conversely, supportive unit management and co-worker relationships had a positive influence on safe medication practices.

Workplace support is important not just within a group of health professionals, but also across professional groups. Adhikari, Tocher, Smith, Corcoran, and MacArthur (2014) conducted a qualitative study that used ethnographic observation with an appreciative inquiry approach to explore medication management practices on two inpatient units. Through workplace observations on two units in separate hospitals, in-depth interviews with nurses, and focus and peer group discussions with students from three higher education academic institutions, areas of excellence in medication management practices were identified for use as exemplars, as well as areas of medication safety that needed improvement. Because medication management is a very complex process that has multiple participants from different professions, the actions of one single profession will never solve all the problems in the process. For nurses, it was identified that although use of the "5-rights" of medication administration is an important safety tool during medication administration, it does not go far enough and it is important for nurses to collaborate with interprofessional team members to provide safe and holistic medication management. In other words, it is critical for patient safety that nurses, and other health care professionals, get out of their "stovepipes." To be able to achieve the safe, holistic care patients and organizations require, new nurses need to not only have a strong foundation in pharmacology and medication safety practices, but they also need to be educated in and experience interprofessional practice during their academic programs. In addition, ongoing in-service programs need to be instituted in the workplace to maximize effective interprofessional teamwork.

Tool. The term tool, as a concept within the theory of situated cognition, encompasses prior knowledge, artifacts, and technology, all of which are discussed separately below. When applied to medication management, prior knowledge as a tool is sometimes difficult to differentiate from the application of knowledge and skills seen in the concept of community because it is not always clear whether an error occurred due to a lack of knowledge or a failure to apply the knowledge and skills appropriately in a given situation. For the purposes of this study, any investigation of errors due to a lack of knowledge was seen as a tool failure, whereas the failure to appropriately apply what is considered foundational knowledge and skills of a competent nurse, e.g., following the “5-rights” of medication administration, was considered a community issue.

Prior knowledge. The focus of this study was on new graduate nurses in their first year of practice. The two main opportunities to gain knowledge related to nursing for new graduates are in their prelicensure nursing program and during workplace orientation. In the US, the National Council Licensure Examination for Registered Nurses (NCLEX-RN) is used to determine that a new graduate nurse meets the minimum level of competency to safely practice as an entry level nurse (National Council of State Boards of Nursing, 2015). Once a nurse successfully passes this examination he or she can be considered for licensure by one of the state or territory Boards of Nursing and accept a position as a RN. The new nurse’s transition to practice begins with workplace orientation which can vary widely from short, simple orientations with no additional transition support to extensive structured programs including preceptorships that can last

months (Spector, 2015). Unfortunately, despite a new graduate expertise gap identified by nurse leaders (Berkow, Virkstis, Stewart, & Conway, 2008), and a call for more robust and comprehensive orientation programs to ensure new nurses are competent to provide safe and effective patient care (Benner et al., 2010; Institute of Medicine, 2011; The Joint Commission, 2002), few employers provide evidence-based, comprehensive nurse residencies (Barnett, Minnick, & Norman, 2014; Pittman, Herrera, Bass, & Thompson, 2013).

The variation in levels of new graduate readiness to provide safe care is directly related to medication administration errors (Phua & Tan, 2011). Amster, Marquard, Henneman, and Fisher (2015) used the novel approach of tracking eye movement during a simulated medication administration experience to investigate whether this technique would be a valuable tool in differentiating between rule-based and knowledge-based medication administration errors. A modified Einhoven error model was used in the study to identify the occurrence of a rule-based error when a student did not use available information that would have identified the error, e.g., medication record or allergy band information. A knowledge-base error was committed when a student was unable to apply pharmacology knowledge when administering a medication, e.g., did not know a patient with a penicillin allergy should not be given amoxicillin. Participants (n=12) were given orders to administer amoxicillin to a patient (manikin) with a documented penicillin allergy in a simulated patient care area. Information was provided about the patient's medication allergy in separate medical and medication charts, on a wrist band on the

patient's arm, and verbally by a live actor, if the student asked the patient about allergies. Videos were analyzed and it was found that although all participants read the order and checked two or more other allergy identifiers, 40% still administered the amoxicillin. There was no significant difference between the number of eye fixations on the medication order or allergy information locations between the two groups. The findings suggested the students made knowledge-based errors because they all followed appropriate procedures (rules) during the medication administration process. This has important implications for education, because it highlights the need to evaluate both knowledge and procedural competency when "checking-off" students related to medication administration.

The small number of participants and the fact that it was conducted at only one nursing program, were definite limitations of this study. It was not possible to assign students randomly because it was not known who would make the medication error and who wouldn't, so post hoc analysis of the two groups was required. In addition, an assumption was made that the eye-mind hypothesis of Just and Carpenter (1980) was true, which posits that a person is actually thinking about the things that their eyes fixate on. It was believed by the researchers that although this hypothesis may not hold true, it provides a reasonable foundation for this area of exploratory research.

Simonsen, Daehlin, Johansson and Farup (2014) compared pharmacology knowledge, certainty concerning that knowledge, and a calculated risk of error between graduating nursing students and experienced nurses. A multiple choice test was used to

evaluate knowledge of pharmacology, drug management, and drug dosage calculation. The answer to each question was assigned a certainty score of 0-3 by the participant (0= very uncertain) and a risk of error of 0-3 was calculated by a researcher (3 indicating high risk; participant was certain that a wrong answer was correct). Based on test scores, the knowledge of the nurses (68.9% correct) was found to be significantly higher than the students (61.5% correct) with the greatest difference seen in drug management and dose calculations. Nurses also reported higher levels of certainty and were at lower risk for error on all topics. New graduate nurses were found to have developed knowledge levels equivalent to the experienced nurses within their first year of practice. Of concern was the fact that although the nurses score higher than the students, the overall low scores indicate elevated risk for error. In contrast to this and other studies (Lan et al., 2014), Lim and Honey (2014) did not find a lack of pharmacological knowledge in new graduate nurses. They did identify areas that needed improvement and recommended new graduate orientation include review of drugs specific to the work setting and additional education on new drugs.

Artifacts. Artifacts related to medication management include non-technological items used during any phase of the process of prescribing, dispensing, preparation, administration, and monitoring, e.g., needles, syringes, medicine cups, paper provider order forms, medication packaging, and non-electronic references. This type of tool is the least reported in the literature and most reports are older studies. The majority of the studies were related to pediatric medication dosing, with three of the four studies specific

to pediatric resuscitation (Feleke et al., 2009; Hohenhaus et al., 2008; Moreira et al., 2015; Wong, Taylor, Thompson, & Tuthill, 2009). Two additional studies referred to the impact of drug package condition or labeling on medication errors (Mrayyan & Al-Atiyyat, 2011; Yamamoto & Kanemori, 2010).

The three pediatric resuscitation studies all used simulation to test color-coded tools designed to improve medication administration accuracy during pediatric resuscitations. Hohenhaus et al. (2008) used in-situ simulation in a controlled, pre/post intervention study to investigate the effect of an education intervention and the use of a new color-coded tool on medication administration. Nurse performance on medication administration during a pediatric emergency response was the primary outcome measure, and was evaluated based on data collected by trained observers during simulation and from video review. Four geographically dispersed sites within one hospital system participated in the study, and included the emergency departments (EDs) in one children's hospital and three community hospitals. All ED nurses at the participating sites were randomized to participate or not participate. Any nurse randomized to participate could opt out of the study if they chose. Scheduled pediatric resuscitation/stabilization simulations were conducted in the EDs at the beginning of the study. All four sites used the Broselow length-based resuscitation tape prior to the study. A Broselow tape is used to measure a child's height (length when lying) during pediatric emergencies to identify appropriate size or weight specific medical interventions such as drug doses, defibrillation settings, or equipment size. At the two intervention sites, a

lecture-style educational session was provided that focused on medication administration using the Broselow tape and a new color-coded tool (Color Coding Kids Hospital System) which is designed to be used with the Broselow tape. The sessions were taught by the inventors of the two systems. A second round of in-situ simulations were conducted at all participating EDs six months after implementation of the new color-coded tool. Nurse performance was measure pre- and post-intervention on five steps: 1) “Converting the dose of medication,” 2) “Selecting the correct medication,” 3) “Properly preparing the medication,” 4) “Measuring the medication dose,” and 5) “Time required to convert and measure the medication dose” (Hohenhaus et al., 2008, pp. 236–237). There were varying results with only some improvement seen in converting doses and measuring doses in the intervention group compared to the control group. Phenobarbital dosing accuracy actually decreased for the intervention group when the new tool was available. The researchers attributed this to the fact that some nurses did not use the tool even when it was available, available drug concentration differed from what was listed on the tool which caused confusion, although formal education had been provided the nurses did not appear to be familiar with the tool, and even those who used the tool did not seem to trust the dose listed and did their own calculations to decide on the dose to be administered. Of particular concern was the discovery that nurses had great difficulty preparing and administering the correct dose of ceftriaxone, a common pediatric resuscitation medication, both pre- and post-intervention. It was believed that incomplete package labeling for intravenous use caused confusion, which was not consistently

corrected even with pharmacist consultation. This study identified that while standardizing medication doses for pediatric resuscitations may improve patient safety, there were several barriers to successful implementation of the new tool. Areas that would require intervention before widespread implementation of the color-coded tool included system issues, to ensure emergency medications were available in the same concentrations called for by the tool and accompanied by clear preparation instructions, structured opportunities to practice with the tool and related medications, and an evaluation of human factors including a simplified system for nurses to reference medication information.

Feleke et al. (2009) addressed the same issue of safe medication administration during pediatric resuscitations as Hohenhaus et al. (2008), but only used the Broselow tape and added color-coded premixed syringes, called the Color Coded Medication Safety (CCMS) system, developed by the researchers and associated with the color zones on the Broselow tape. This simplified approach avoided the issues of drug concentration and instruction availability as well as medication preparation accuracy by the nurses. Feleke et al. (2009) conducted a prospective one-group pre-test/post-test observational study to evaluate how long it would take nurses to convert medications from milligrams to milliliters (to match the Broselow tape recommended doses) and to describe how they would prepare the medication during in-situ simulated pediatric resuscitation scenarios. Outcome measures were time to task completion and number of errors made, with data collected on time from doctor's order to conversion and administration description, the

dose conversion in milliliters, a verbal description of the dilution, and the described length of administration time. A convenience sample of 19 RNs from three community hospital EDs participated in a pre-intervention testing scenario, an intervention educational session to train them on the use of the CCMS system, and a post-intervention testing session. In the pre-intervention scenario 160 medication and infusion orders were given using 10 medications with a resulting conversion error rate of 25.6%. The conversion error rate for the same number of orders and medications dropped to 2.5% in the post intervention scenarios. Drug dilution accuracy improved from a 27.5% error rate pre-intervention to a 0.63% error rate post-intervention. There was a 54.7% error rate in the speed of medication administration pre-intervention which dropped to 3.9% post intervention. Time to task completion was significantly shorter for pediatric ED nurses using the CCMS system and even greater time improvements were seen for community ED nurses. Pre-intervention, only 16% of the nurses identified 10-fold order errors build into the scenarios, but 88% of the order errors were identified post-intervention. Although the study was limited by a small, convenience sample and lacked randomization, the results showed a dramatic improvement in errors with the use of the tool. Because emergency situations are stressful for health care professionals, systems such as the one used in this study are promising tools for reducing the cognitive load and leading to safer patient care.

In 2015, Moreira et al. reported a study very similar to the study by Feleke et al. (2009) with the addition of physicians to the care team and a more authentic scenario for

the simulated resuscitation experience. This study was a prospective, block-randomized, crossover study in which 10 physician-nurse teams participated in two in-situ, simulated pediatric resuscitation scenarios. In one scenario a team was provided with medication preparations to administer in traditional packaging and in the other scenario they used color-coded, prefilled syringes that were based on the Broselow tape weight-based dosing system. The simulation sessions were video recorded and data were extracted by blinded reviewers. Similar to the earlier study results, there was a significant difference in the time and accuracy of medication dosing between the traditional and color-coded groups. The use of the color-coded medications resulted in a median dose time of 19 seconds compared to the traditional medication time of 47 seconds. There were zero critical errors (0%) made in the 123 doses administered using the color-coded system compared to 20 critical errors (17%) in the 118 doses given using the traditional system. Despite the impressive findings from this study one of the key limitations is that color-coded syringes are not yet commercially available and the researchers found it difficult to accurately code the syringes that are currently available because the differences between some doses was as small as 1/8" or 3/32". Even with the challenge of very small differences between doses, this study demonstrates how a well-designed tool can support the cognitive processes of caregivers, resulting in more accurate and timely medication administration.

Technology. Technology impacts medication management by providing automated versions of earlier artifacts, such as provider orders, but with greatly enhanced

functionality through decision-support tools and improved information flow. It is also important because it provides completely new tools intended to improve patient safety such as bar-code medication administration (BCMA) scanners. Technology has been seen as one of the promising tools to reduce medication errors (Aspden et al., 2007), and has been actively investigated in recent years (Ching, Williams, Idemoto, & Blackmore, 2014; Cousein et al., 2014; Damhoff, Kuhn, & Baker-Justice, 2014; Ferguson et al., 2014; FitzHenry et al., 2011; McComas, Riingen, & Chae Kim, 2014; Morriss Jr., Abramowitz, Carmen, & Wallis, 2009; Rack, Dudjak, & Wolf, 2012).

Since the passing of the HITECH Act in 2009 there has been a rapid and widespread implementation of EHRs and other health care technology (American Recovery and Reinvestment Act, 2009). This has had a significant impact on how care is provided by changing processes as well as the equipment used to carry out care. Technology related studies prior to the passing of HITECH tended to investigate nurse perceptions of technology implementation (Rosenkoetter, Bowcutt, Khasanshina, Chernecky, & Wall, 2008), education programs related to new technology (Straight, 2008), or the general impact of technology on medication management (Skibinski, White, Lin, Dong, & Wu, 2007) rather than the impact on patient safety related to prescribing or administration errors (Koppel, Wetterneck, Telles, & Karsh, 2008). One exception is the study by FitzHenry et al. (2007) which used a 5-year retrospective review of charts with medication orders that had been entered in the hospital's computerized provider order entry (CPOE) system. Chart audits compared the actual time a medication was

administered with the expected time from the CPOE system and revealed a 12.6% rate of dose omissions, a median lag from expected first dose to actual dose of 27 minutes, and dose schedule shifting by nursing staff from what was ordered. Wrong doses and unexpected doses were found in less than 1% of the administration opportunities. In a time when expectations were very high that technology would have a positive impact on medication errors, the researchers presented a “dose of reality” with their conclusions that, even with the implementation of CPOE and bar-code medication administration (BCMA), medication administration errors may continue unless other areas of the medication management processes are addressed, such as identifying the true urgency of an order, prevention of duplicative orders, and safe methods for adjusting dosing schedules.

After the enactment of HITECH there was an explosion of research related to the use of technology in health care with the focus specifically related to medication management outcomes. One of the most studied technologies was the use of bar-code scanning during the medication administration process (FitzHenry et al., 2011; Stamp & Willis, 2010; Trbovich, Pinkney, Cafazzo, & Easty, 2010). Some studies continued to be published related to nurse satisfaction and attitudes related to the use of BCMA (Fowler, Sohler, & Zarillo, 2009; Gooder, 2011; Marini, Hasman, Huijter, & Dimassi, 2010), but increasing numbers of studies began measuring the impact of the technology on medication administration, identifying error reduction rates as high as 56% based on direct observation (DeYoung, VanderKooi, & Barletta, 2009), and a decrease in time

spent on administration by 50% (Tsai, Sun, & Taur, 2010). Studies on transition to automated dispensing also reported positive results in studies based on questionnaire data (Chapuis et al., 2010) as well as observations (Cousein et al., 2014). One area of technology implementation with varying results was related to electronic medication administration records (eMARs). Based on a retrospective review of reports from a voluntary error reporting system, Choo, Johnson, and Manias (2014) found no reduction in medication errors after the implementation of an eMAR. A more rigorous evaluation of eMAR implementation by McComas, Riingen and Chae Kim (2014) using medication administration observations and retrospective review of error reports for data collection reported a slight increase in administration time, but a significant decrease in error rates after implementation of an eMAR. Consistent with the studies cited above, Cousein et al. (2014) reiterated the important point that one technology will not solve the problem of medication errors and there needs to be a large spectrum of complementary solutions applied to the issue to achieve safe patient care.

Activity. According to the theory of situated cognition, activities need to be authentic and replicate the real world. This applies to medication management from the perspective of how new nurses learn about medications and their role in safe medication management, as well as investigations of how medications are being managed by nurses in the real world. Authentic research settings will result in more accurate, real world observations and more exact information on how to prevent future errors. If student nurses do not acquire the knowledge and skills they need to safely manage medications in

an authentic, real world setting it is much more difficult for them to transfer what they have learned in their academic setting into a clinical setting. This point was especially relevant to this study, because, based on the author's experience and anecdotal information, it is suggested that new nurses are frequently not being educated in an authentic environment and, therefore, are not being appropriately prepared for safe practice. Unfortunately, there is very limited information in the literature about the authenticity of the activities used in nursing education in an academic or workplace setting, with the exception of simulation. Even with recent simulation studies there is rarely enough detail provided about the experience to identify the level of authenticity the students experience. Simulation is a relatively new teaching strategy and standards of best practice have only been published in the last five years, so there is wide variation in the experiences provided to students (Boese et al., 2013; Decker et al., 2013; Franklin et al., 2013; Gloe et al., 2013; Lioce et al., 2013; Meakim et al., 2013).

Education. Educators have recognized for a number of years that student perceptions of preparedness for medication administration increased after opportunities to practice in simulated environments with timely feedback (Latter, Rycroft-Malone, Yerrell, & Shaw, 2001). When assessing medication administration competency, there is no standardized evaluation method used in nursing education (Gonzales, 2012), nor is there clarity on whether competency is gained from simulated clinical experiences, practice during clinical placements, or a combination of the two (Chan, 2002, 2003; Gonzol & Newby, 2013; Henderson, Cooke, Creedy, & Walker, 2012).

In a phenomenological qualitative study using focus groups, Krautscheid, Orton, Chorpenning and Ryerson (2011) found that students valued authentic activities such as faculty demonstrations and repetitive practice with feedback, and asked for more experience with communication and conflict management skills to deal with the real-world issues of interruptions, distractions, and computer alerts. Pauly-O'Neill and Prion (2013) conducted a pilot, evaluative study to determine the overall influence of a mixed educational approach on student knowledge, skills and self-confidence with administering medications in the pediatric population. All students in a junior-level pediatrics course (number not reported), in addition to class lecture, rotated between clinical and simulated clinical experiences on a two-week rotation, for a total of 50 hours of on-unit clinical and 40 hours of simulation. All students took a knowledge pretest related to medication management, and 32 students completed an optional posttest. There was a statistically and practically significant difference in paired pre- and post-test scores. Similar gains were also seen in student self-confidence related to medication calculations, dilutions and delivery methods. Unfortunately, because it was a mixed experience study, it is not possible to determine one type of experience was more effective than the other.

Practice. There are even fewer reports of the effect of authentic experiences on medication errors in the practice setting than in the educational setting. Schneider et al. (2006) investigated the impact of an interactive CD-ROM educational program on medication administration errors in a randomized, controlled, non-blinded study with 30

RNs from three community hospitals. Direct observations were conducted to determine pre- and post-intervention error rates for all participants. Nurses were randomized to either the control or intervention groups. The intervention group completed the CD-ROM learning program which presented information on safe medication practices and included interactive medication administration scenarios. The post intervention observations showed a significant decrease in errors due to safe practice violations by the intervention group. A notable limitation of the study was the small convenience sample used.

In a study comparing the effect of traditional lecture versus simulation-based training, Ford et al. (2010) used a combination of observation and testing to evaluate medication administration error rates. This prospective, parallel, controlled study investigated the impact of the two different educational interventions on medication error rates in a coronary critical care unit (CCU) and a medical intensive care unit (MICU). Twenty-four nurses were observed administering medication (12 in CCU and 12 in MICU) pre- and post-intervention, for a total of 880 doses (402 CCU, 478 MICU). After initial observations the educational intervention was carried out based on the errors identified during the observations. All nurses in the CCU and MICU were invited to participate in a 20- to 30-minute educational session about common medication errors, whether they were participating in the study or not. Each nurse who attended was asked to complete a short multiple choice quiz before and after the educational session, as well as a five question Likert-type scale subjective evaluation. The CCU nurses were taught

using a simulation-based training session, whereas the MICU nurses attended a traditional didactic lecture. The participants were observed two more times after the intervention, at eight and 12 weeks. All observations were completed by pharmacists trained in the observation procedure. The medication administration error rate for CCU nurses dropped from 30.8% pre-intervention to 4.0% at the initial post-simulation training observation, and continued to be significantly lower at 6.7% 12 weeks post-intervention. In the MICU the pre-intervention error rate was 20.8% and 22.7 % after the lecture-style education session, with a significant increase to 36.7% at the 12 weeks post-intervention. The post-tests for both groups showed significant improvement, but there was no significant difference between the groups on mean pre- and post-quiz scores. The small number of participants and the fact that the study was only carried out at one facility limits the generalizability of the findings, but the large differences between the two groups is intriguing. Both teaching techniques were shown to be effective based on the quiz results, and the lack of differences between the groups on their scores support consistent presentation of the content. Also, because the one key difference between the two groups was the type of learning experience, the findings provide support for the premise that authentic learning experiences can enhance a person's ability to transfer knowledge into practice.

Context. The concept of context relates to the environment in which individuals function, and gives structure to their cognition. The concepts of community, tool, and activity are all impacted by the context or environment in which an individual functions.

For the purposes of this study, the literature that specifically relates to the nurse's physical learning or work environment and system issues, as they impact medication management education or work activities, was considered related to context. The perceived atmosphere of the academic or work environment is discussed as part of culture under the concept of community.

Practice environment. The two main areas where the practice environment have been found to impact medication errors are related to the physical environment and organizational systems. When considering the context of the practice environment, of note is the fact that medication errors are not just a problem in the US (World Health Organization, 2014). Other developed countries have similar problems because they also have advanced health care systems (Balkrishnan & Patel, 2010; National Patient Safety Agency, 2009). In developing countries, medication error issues become even more complex because the health system is less advanced and there are issues such as medication supply problems and limited or nonexistent policies related to medication administration or error reporting systems. Acheampong, Tetteh, and Anto (2015) reported that the error rate for "wrong time" doses would have decreased from 27.2% to 12.8% when errors due to "drug availability" were excluded. In Ghana, where the study was carried out, patients and their family members are responsible for providing medications ordered by the health provider. A study in Nigeria by Oshikoya et al. (2013) identified that even though 82% of their participants were nursing officers or matrons, 24% were not sure if there were policies to prevent medication errors and 42% did not

know if there was an error reporting system in their hospital. While these are real and disturbing issues in some parts of the world, it is heartening that there are active nurse researchers who recognize that their health systems can be improved and are gathering the data to enhance patient safety in their countries.

The impact of the physical work environment was highlighted by Mahmood, Chaudhury, and Valente (2011) when the nurses in their study identified several issues in their workplace that they believed lead to medication errors. Some of the problematic areas identified in the environment included, lack of storage and charting space, size of the medication room, visibility of all of the nursing unit, and noise. The nurses reported that environmental issues had contributed to several different types of medication errors with the most frequent being missed medication doses and the wrong time of administration. The perceived causes for the medication errors were identified as being related to staff and organizational problems, overwork and stress of the staff, high patient to nurse ratio, and a lack of teamwork, as well as physical environmental issues, such as lack of space for charting, poor layout of the nursing unit and lack of privacy in the nurse workspace. The authors identified that to achieve a meaningful reduction in medication error rates, it is important to consider modifying current health care structures and, for future buildings, to ensure design professionals take into account the impact of the physical environment on error occurrence.

One of the most well-known practice environmental issues related to medication errors are distractions and interruptions. As interruptions or attention demands increased,

e.g., requests for information, patient emergencies, unexpected increase in census or patient acuity, change of shift, medication errors and nursing workload increased errors have been found to increase (Cottney & Innes, 2015; Despina, 2014; Elganzouri, Standish, & Androwich, 2009; Keers et al., 2015; Kreckler, Catchpole, Bottomley, Handa, & McCulloch, 2008; Palese, Sartor, Costaperaria, & Bresadola, 2009; Pham et al., 2011; Prakash et al., 2014; Westbrook, Woods, Rob, Dunsmuir, & Day, 2010). Verweij et al. (2014) reported on a creative intervention to decrease interruptions. When the nurses wore tabards with bold printing that stated “Do not disturb” interruptions were reduced by up to 75% and medication administration errors decreased by up to 66%. There were concerns expressed by the nurses that wearing the tabards may make them unapproachable by family members when needed or that continuity of care might be affected if other health care team members chose not to remain in the area until they were finished to talk to them. Although most reports in the literature described interruptions as a negative occurrence, Sitterding, Ebright, Broome, Patterson, and Wuchner (2014) challenged that view. Their study was based on a situational awareness model and used cognitive task analysis to analyze interruptions. They found that despite immense complexity of task handling during medication administration processes, nurses could effectively pause medication administration, prioritize information from an incoming interruption, and act on it if it was urgent, returning to medication administration later, or divert the interruption information if it was secondary to their medication task without an increase in medication errors.

The main areas impacting medication errors related to organizational systems are nurse workload, staffing, and risk management. There is support in the literature for a link between workload and medication error, but the biggest challenge in effecting change is that there is not an agreed upon standard for workload and many studies are based on recalled or perceived workload (Abdar et al., 2014; Berdot et al., 2012; Duffield et al., 2011; McDowell, Ferner, & Ferner, 2009). Adequate staffing was frequently cited as a factor that could support safe medication administration or, if inadequate, lead to dramatically increased incidence of errors (Cho, Chin, Kim, & Hong, 2016; Donaldson, Aydin, & Fridman, 2014; Ehsani et al., 2013; Frith, Anderson, Tseng, & Fong, 2012; Güneş et al., 2014; Wilkins & Shields, 2008), although Mark and Belyea (2009) reported unequivocally that, using autoregressive latent trajectory (ALT) modeling, they found no relationship between nurse staffing and medication errors either cross-sectionally or longitudinally. Keers, Williams, Cooke, and Ashcroft (2015) used Reason's (1990) model of accident causation in a qualitative study to investigate the underlying causes of intravenous medication errors. They found that there are numerous complex interactions between latent and active failures leading to the errors and multimodal interventions will be needed to reduce error rates in the future. Volpe et al. (2014) reported complementary findings when they stated that medication error risk factors are known and it is now time to stop prosecution and punishment of professionals who make errors, and to implement systems for error prevention that will place barriers between the hazards and potential errors. Similarly, Drach-Zahavy et al. (2014) encouraged health care organizations to

move on from a focus on preventing errors to managing them because human factors make some errors inevitable. In an effort to better manage errors it is important to understand how an organization learns from errors that have been made.

Another factor often cited in studies carried out in countries with less advanced health systems is the lack of, or underdeveloped, mandatory error reporting system with a clear definition of what constituted a medication error (Güneş et al., 2014; Hajibabaei et al., 2014; Mostafaei et al., 2014; Oshikoya et al., 2013), thus leaving it up to the nurse's opinion as to whether an error had occurred and if it was worth reporting. As noted above, when the system does not support reporting and error investigation it is very challenging to make progress in improving care safety.

Learning environment. The marked absence of studies related to the impact of context on the learning environment indicates an area ready for exploration. This is especially pertinent to this study because context provides the landscape in which community, tools, and activities interact. If we do not understand the impact of context on the other parts of the learning process, then it is not possible to fully identify the most effective way to prepare new nurses for safe medication management.

Medication Management Education and Orientation

To understand the whole picture of medication errors it is important to consider the methods used to prepare new graduate nurses to manage medications. From the viewpoint of the theory of situated cognition, the community, tools, activities, and learning context of educational activities have a strong impact on a nurse's ability to

transfer their knowledge and skills from an academic setting to a clinical setting.

Unfortunately, there is little in the literature that indicates best practices for teaching medication management (Gonzales, 2012). In an ideal world, this would be the longest section in this chapter because it would demonstrate that educational programs have a strong base of evidence to guide them in how to best prepare new nurses to practice safely, and thus lead to declining number of medication errors. Unfortunately, this is not the case. There is a great deal published on **what** to teach (Aspden et al., 2007; Cronenwett et al., 2007; Perry, Potter, & Ostendorf, 2014; Potter, Perry, Stockert, & Hall, 2012; The Joint Commission, 2015), but extremely little on **how** to effectively teach the information (Oermann, 2015).

Numerous textbooks outline key content the authors believe will provide a foundational knowledge of pharmacology, and the skills and procedures to administer medication. Safety information from organizations with a focus on patient care quality and safety, such as the Joint Commission, Institute for Safe Medication Practices (ISPM), and Quality and Safety Education for Nurses (QSEN), is provided in the textbooks, but whether this material is taught in an authentic manner that is transferable to real-world settings or using artificial classroom and lab settings is not known. Is nursing education relying on rote memorization of medication information and management skills, yet expecting application in the clinical setting? Where is the evidence that nursing education programs are making a difference in patient safety?

Some of the same questions can be asked of workplace orientation programs. New graduate nurses are required to complete an orientation program when they are hired by a health care organization. Generally, the orientation programs are made up of two main parts: organization orientation and unit-specific orientation. Orientation to the organization is frequently similar for all new employees, including information related to their employment, general policies and procedures, and life safety training or verification (Baxter, 2010; Kennedy et al., 2012; Kostovich & Clementi, 2014).

Unit-specific orientation focuses on the unit policies and procedures, as well as information and skills specific to the patient population usually cared for on the unit. Unit-specific orientation is often carried out using a one-on-one method, with one new nurse being paired with an experienced preceptor. The knowledge, skills, experience, and teaching focus of preceptors varies preceptor to preceptor, unit to unit, and organization to organization (Bortolotto, 2015).

Orientation is a critical time in a new nurse's career, and for the health care organization. A systematic review of the literature by Kennedy et al. (2012) showed that little has changed in nursing orientation in the last 60 years. They identified that orientation programs generally use traditional didactic teaching strategies with competency check-offs, despite evidence that the programs would be more cost-effective and improve patient safety if they were more learner-focused and geared to meet the needs of each nurse. The orientation period provides a window of opportunity for error prevention by identifying and correcting any deficiencies in medication management

knowledge and skills before the new nurses begins independent practice (Kennedy et al., 2012)(Kennedy et al., 2012). It has been shown that there is a correlation between the number of years of nurse experience and the likelihood of making a medication error, with more experienced nurses making fewer errors (Fasolino & Snyder, 2012).

Therefore, it is critical that new nurses are made aware of common error causes and ways to prevent them. Failure to address deficits can lead not only to patient injury or death, and financial cost for the organization (Grech, 2011; James, 2013), but also negatively impact the nurse's career, physical, and mental health (Grech, 2011; Maiden, Georges, & Connelly, 2011; Pelliciotti & Kimura, 2010).

The lack of evidence related to the most effective way to educate new nurses and orient nurses to the workplace is the impetus for this study. Through an exploratory investigation of whether new nurses are being taught to manage medications in an authentic environment with the tools, community, and activities that reasonably reproduce the clinical setting in which they are expected to function, it can be discovered whether students are being given the opportunity to learn in a way that allows them to transfer their skills and knowledge to provide safe care in clinical practice.

Summary

Medication administration safety and error prevention is a priority topic in United States health care today (Aspden et al., 2007; Brady, Malone, & Fleming, 2009; Cronenwett et al., 2007; The Joint Commission, 2015). The literature clearly demonstrates that a lot is known about the influence of the community (culture, people,

and relationships) on safe medication management. The ongoing evolution away from a culture of blame and punitive reaction to errors, and toward the development of a culture of safety, has been shown to result in greater safety awareness, safer and more cost-effective care, and increased error reporting (Kagan & Barnoy, 2008; Moody et al., 2006). Because it is recognized that human error will happen (Keers et al., 2015), the development of a supportive environment is important because it has resulted in a decrease in errors and an increase in error reporting which is critical to the identification and mitigation of both systemic and individual error causes (Flynn et al., 2012; Nieva & Sorra, 2003). Without accurate error reporting it is very difficult to clearly identify error causes and effective ways to address them (Kagan & Barnoy, 2008). The need for people to follow organizational and professional guidelines is important to error prevention (Donaldson, Aydin, Fridman, et al., 2014; Xu et al., 2014), but it is also important to understand that no profession functions in a vacuum in health care, and interprofessional collaboration is an important part of providing safe and effective care (Adhikari et al., 2014).

Additional studies have clarified the impact of tools (prior knowledge, artifacts, and technology) on medication related errors and error mitigation. A new nurse will only be able to effectively use non-technological and technological tools to safely manage medications if he or she is competent in medication management knowledge and skills (Amster et al., 2015; Feleke et al., 2009; McComas et al., 2014; Simonsen et al., 2014). It is important to note that although technology has been seen as a very promising tool for

reducing medication error rates (Aspden et al., 2007), it is not a universal solution for all error causes, but rather one of a variety of complementary interventions that are needed to achieve safer patient care (Cousein et al., 2014).

An area where there has been very limited investigation is related to the effect of authentic activities on learning safe medication management in both the educational and practice arenas. Students have identified that they felt more prepared for medication administration after simulated experiences (Latter et al., 2001), and they have reported that authentic activities such as faculty demonstrations and repetitive practice with feedback were valuable (Krautscheid et al., 2011). One study demonstrated a significant improvement in medication error rates after the use of simulation versus a traditional lecture educational intervention in critical care nurses (Ford et al., 2010), but there is no body of literature that identifies effective strategies or best practices related to the use of authentic environments for teaching medication management. The optimal frequency or pattern of the use of authentic experiences in prelicensure nursing education or orientation is also not known. These are concerning gaps in knowledge considering the importance of authentic experiences in translation of learning experiences into safe practice.

The effect of context (the environment for practice or education) on medication management in the practice setting has been reported in only a few studies. The main areas that have been studied related to context and medication management are related to distractions and interruptions, nurse workload and staffing, and the availability or lack of

a formalized error reporting system. It has been clearly demonstrated that increased distractions and interruptions can lead to higher medication error rates (Cottney & Innes, 2015; Keers et al., 2013; Prakash et al., 2014), but concerns have been raised that making the nurse less accessible to patients, family, members and other health care workers may have a negative effect on continuity or timeliness of care (Verweij et al., 2014). There is some support in the literature that links workload to medication errors (Berdot et al., 2012; Duffield et al., 2011), but the biggest challenges in identifying effective change strategies is that there is no universally agreed upon standard for workload and the data available are often based on recall or perceived workload (Cottney & Innes, 2015). Similar to the need to have clear definitions and data related to nursing workload to be able to accurately identify effective strategies to reduce medication errors, there is also a need to have a formalized reporting system for errors that will provide decisions on error prevention and mitigation. One of the challenges in many developing countries is the lack of or underutilized mandatory reporting systems (Güneş et al., 2014; Hajibabaei et al., 2014; Mostafaei et al., 2014). Achieving significant health system level improvements in medication errors will be very difficult until a better data driven understanding of their systems can be achieved.

Although there is information available related to the impact of context on medication management in the practice setting, there is virtually nothing in the literature related to the consideration of the importance of context in teaching or evaluating medication management in nursing education. Without an understanding of the context

or environment in which the other components of learning (community, tools, and activities) are employed it will not be possible to identify the most effective way to educate new nurses to safely manage medications. This study endeavored to describe the current context in which learning is taking place to provide a foundation for future research.

There is also currently a lack of empirical data to guide educational programs or workplace orientation programs in what changes need to be made and how to make them to significantly improve medication administration practices and patient safety. Information on what content to teach is readily available from textbooks, safety organizations, and accrediting bodies, but the most effective strategies or best practices for teaching medication management have not been identified either for prelicensure education or workplace orientation.

Through the preceding discussion of the origins, meaning, logical adequacy and usefulness of the theory of situated cognition, it was shown that this theory provides both flexibility for use in many settings and sufficient clarity of concepts to serve as a useful model to aid in the discovery of needed empirical evidence related to medication management education. This exploratory study sought to advance the knowledge related to this topic by surveying three groups 1) North Carolina (NC) hospital staff education departments, 2) NC RN education programs, and 3) all RNs in NC working in acute care settings who received their initial license to practice nursing between June 1, 2015 and May 31, 2016. The knowledge gained will benefit nursing education and orientation

programs by providing them with data to help develop a safer more effective nurse who is ready for today's fast-paced and technology intense health care world.

CHAPTER III

METHODS

There is currently a lack of evidence in the literature to guide education and workplace orientation programs in the most effective way to prepare new nurses to safely manage medications. It is not known whether the methods currently being used are meeting the needs of the new graduates, nor whether the content and teaching strategies used in prelicensure education and workplace orientation are effective in preventing medication administration errors. What is known is that there are major problems with patient injury and death due to medication errors made by US health care professionals. Rather than look at the causes and results of failures in medication management, which has been extensively explored in studies around the world, this study began at the beginning and explored what was taking place at the start of the process of preparing new nurses to safely manage medications.

This study addressed the following specific aims and research questions:

1. Identify new graduate RN perceptions about medication error causes, identification, and reporting.
 - Q1: What are new graduate RN perceptions about causes of medication errors?
 - Q2: What do new graduate RNs identify as a medication error?
 - Q3: What medication errors do new graduate RNs believe should be reported to the patient's physician?

Q4: What medication errors do new graduate RNs believe should be reported on an incident report?

Q5: What are new graduate RN perceptions about reporting medication errors?

Q6: Do new graduate RN perceptions of medication errors differ based on demographic characteristics?

2. Examine prelicensure nursing education program experiences that new graduate RNs report were effective in preparing them to safely manage medications and what additional experiences would have made them better prepared.

Q7: What do new graduate RNs report were the courses, teaching strategies, activities, or equipment used in their prelicensure nursing programs that effectively prepared them to safely manage medications (prepare, administer, and monitor)?

Q8: What do new graduate RNs think could have been done differently in their nursing education program to better prepare them to safely manage medications?

Q9: What do new graduate RNs report were the review topics, teaching strategies, activities, or equipment used in their workplace orientation that effectively prepared them to safely manage medications (prepare, administer, and monitor)?

Q10: What do new graduate RNs think could have been done differently in their workplace orientation to better prepare them to safely manage medications?

Q11: Do nurse-reported effective preparation experiences differ based on demographic characteristics?

3. Describe how new graduate RNs are being prepared to safely administer medications in prelicensure programs in NC.

Q12: Where in the nursing curriculum is new medication management content most frequently taught?

Q13: What teaching strategies are most commonly used to teach safe medication management?

Q14: What activities and equipment are most frequently used to teach safe medication management?

Q15: How do the classes, teaching strategies, activities, and equipment used to teach medication management in nursing programs compare to the effective preparation experiences reported by new graduate RNs?

4. Describe how new graduate RN workplace orientation ensures competency to safely manage medications.

Q16: What review topics, teaching strategies, activities, or equipment are used during new graduate RN workplace orientation to review safe medication management?

Q17: How are new graduate RNs evaluated to determine medication management competency during workplace orientation?

Q18: How do the content reviews, teaching strategies, activities, and equipment used to review safe medication management during workplace orientation programs compare to the effective experiences reported by new graduate RNs?

Design

This study used an exploratory, cross-sectional, descriptive design with online surveys to investigate new graduate RN perceptions about medication errors, their experiences with learning to administer medications in their education programs, and how their workplace orientation impacted their transition to practice related to medication management. It also examined what activities nursing programs and hospital staff education personnel reported being used to teach and ensure competency related to medication management by new graduate nurses. In addition to the quantitative survey items, the nurses were asked two open-ended questions in an effort to gain greater understanding of what they perceived could have been done differently in their nursing education and workplace orientation programs to more effectively help them learn to safely manage medications. The themes/topics identified by the nurses were compared to the experiences the nursing and orientation programs reported they used to prepare nurses to safely manage medications to identify strengths in current practices and areas for potential improvement or change.

The foundation for the entire study was the theory of situated cognition. This theory explains that the transferability of learning is impacted by the tools, community environment, and authenticity of the activities used when the learning takes place. These three items are also impacted by the overall context within which the learning occurs. To

understand whether nurses are being educated effectively to safely manage medications, one needs to understand the environment and activities that they experience when the teaching is taking place.

Because of the lack of empirical evidence related to medication management education, an exploratory, descriptive design using surveys is most appropriate to begin identifying what is taking place during the education and orientation of new nurses, and the resulting perceptions of new nurses about medication errors. Self-administered surveys allow the researcher to present the exact same questions to a large number of people or organizations in geographically separated locations at a relatively low cost in time and money, as well as provide a greater level of anonymity and reduce the impact of researcher characteristics on responses (Rea & Parker, 2014). One documented drawback to self-administered surveys is that it is not possible to positively identify the individual who is completing the survey (Vogt, Gardner, & Haeffele, 2012; Wood & Kerr, 2011), but this was not believed to be an issue for this study because survey invitations were delivered by email directly to the intended participant or through supervisor referral.

Because this study was exploratory, the best place to start was with the individuals who are participating in the processes. By gathering data at each step, from initial education to beginning nursing practice, the results of this study begin to describe the progression of medication management education and the impact this process has on the key player, the nurse. Once the process is better understood, interventions can be proposed to improve education methods, and ultimately to achieve safer nursing care.

The research questions in this study were straightforward and most of the answers could be obtained through structured questions. The three surveys distributed to new graduate nurses, nursing education programs, and hospital staff development personnel can be found in Appendices B, C, and D. The use of three surveys with questions that link across the surveys were critical in identifying the education and orientation experiences that the nurses reported affected their ability to safely manage medications.

Because the nurse participants were in their first year of practice, and were no more than two years out of nursing school, it should not be difficult for them to recall what took place in their education and orientation programs. The questions in the modified Gladstone scale asked about nurse perceptions related to medication errors. Some of the questions may have raised an awareness of ambiguity about how to properly deal with an actual or potential medication error, but only one question about how many errors the nurse remembers making had the possible potential to cause feelings of discomfort and be impacted by social desirability bias. The researcher designed questions were deliberately written to ask for facts and were worded to be as neutral as possible so as not to imply any judgement of the nurse, school, or health care organization based on the participant's responses.

Each survey question was specifically designed to build evidence for answering one or more research questions. The questions were also linked across surveys so comparisons could be made between what the nurses reported experiencing and the teaching strategies, equipment, and activities described as being used by the education and orientation programs. The survey items were also planned to provide supporting

evidence for the applicability of the theory of situated cognition to improving medication management education and safe clinical practices.

Setting and Sample

This study took place in North Carolina (NC) and surveyed the entire population of new RNs who graduated from their initial RN nursing education program since June 1, 2014 and were initially licensed as RNs by the NC Board of Nursing between June 1, 2015 and May 31, 2016. NC was selected because the researcher resides there, received her nursing education in the state, taught in a NC prelicensure education program, and is active in NC professional organizations. Being known in the state may have increased response rates, especially from nurse educators and staff development personnel. One state was chosen because, although all registered nurses (RNs) take a national licensing examination, Board of Nursing requirements for educational programs vary from state to state. This study also included a survey of all NC acute care hospital staff development departments and all schools of nursing with a prelicensure RN program approved by the NC Board of Nursing. Because of the rapid changes in healthcare and nursing education, the time since nurse graduation was limited to the last two years in an attempt to survey nurses with experiences reflecting current practices in education, orientation, and clinical practice.

New Graduate Nurses

As of July 4, 2016, there were 130,624 RNs licensed to practice nursing in NC with 103,097 of them currently working in nursing (North Carolina Board of Nursing, 2016c). The demographics for RNs in NC are similar to those in the US. In NC 11.6%

of RNs are African American, 81.7% are Caucasian, and 8.3% are male (North Carolina Board of Nursing, 2016c), as compared to the US where, of the almost three million nurses, 12.2% of RNs are African American, 75.7% are Caucasian, and 10.6% are male (US Bureau of Labor Statistics, 2016a). NC is also similar to the US as a whole when assessing the highest level of education of RNs. In NC, 41.0% of the practicing nurses hold a bachelor's degree, as compared to 44.6% in the US; 39.7% of NC nurses have an associate degree and 37.9% have earned the same degree in the US; and there are 5.8% diploma graduates in NC versus 6.9% in the US (Health Resources and Services Administration, 2013; North Carolina Board of Nursing, 2016c). The similarities between nurses in NC as compared to the US as a whole provides a reasonable representation of RNs in the country.

All RNs who graduated from their initial RN education program after June 1, 2014 and were initially licensed to practice nursing in NC between June 1, 2015 and May 31, 2016 were included in this study. Exclusion criteria include graduation from a nursing education program outside of NC, working in a hospital outside of NC, licensed as an RN before June 1, 2015, or completed initial RN education prior to June 1, 2014. These inclusion and exclusion criteria were selected to identify nurses who have experienced current practices in education, orientation, and clinical practice in the nursing programs and hospitals that are also included in the study.

Nursing Education Programs

There are 85 prelicensure RN education programs approved by the NC Board of Nursing (2016a), with 57 (67.1%) of the programs at the associate degree level, 27

(31.7%) baccalaureate level programs, one (1.2%) diploma program, and no entry-level master's programs. This compares to a total of 2244 Board of Nursing approved prelicensure programs in the US made up of 1258 (56.1%) associate degree programs, 890 (39.7%) baccalaureate programs, 44 (2.0%) diploma programs, and 52 (2.3%) entry-level master's programs. Although there is a great variation from state to state in the number of nursing programs (Range 3-211), as well as the concentration of programs per capita, with one program per 58,230 -- 287,810 citizens, NC is similar to the nation as a whole with 85 prelicensure RN programs and one program per 115,430 citizens. In addition to variation in the numbers of programs, there is also variation in program requirements based on individual Board of Nursing guidance and individual curricula. For the purposes of this study, program requirements in NC were considered equivalent to those in other states because graduates must demonstrate the same level of competence as a generalist nurse to pass the national licensure examination.

All prelicensure RN education programs approved by the NC Board of Nursing (North Carolina Board of Nursing, 2016a) were surveyed, including associate degree, baccalaureate, and diploma programs. Accelerated baccalaureate programs for students who already have a bachelor's degree were included in the baccalaureate programs. Two programs were separately approved for associate and baccalaureate degree programs, and one program reported they will not have students until January of 2017. The schools with two approved programs were only surveyed once each, and the program which has not started student instruction was not surveyed, for a total of 82 schools invited to participate in this study.

Snowball sampling was used based on professional contacts of the principal investigator (PI) to identify the faculty member responsible for initial instruction in safe medication management. If the PI is not acquainted with anyone who could provide a contact referral at a school on the NC Board of Nursing list, the school was contacted by telephone or e-mail to obtain the e-mail address of the appropriate faculty member. An e-mail invitation to participate in the study, with the survey link, was sent directly to the identified individual.

Hospitals/Hospital Systems

Hospitals in NC are licensed in two categories by the NC Department of Health and Human Resources (NCDHHS): hospitals and mental health private psychiatric facilities. There were 125 hospitals, or hospital systems, and 11 private psychiatric facilities licensed by the NCDHHS as of June 2016 (NC Department of Health and Human Services, 2016). The hospitals provide 24,376 acute care beds for NC citizens. This equates to one hospital for every 80,342 North Carolinians and one bed for every 412 citizens (North Carolina Department of Health and Human Services, 2016; US Census Bureau, 2016). Although there are more acute care hospitals per capita in the US as a whole, one hospital for every 65,773 people, availability of beds is exactly the same, with one bed per 412 individuals. Despite geographic variation in accessibility of acute care hospital beds in both NC and the US, overall, NC is similar to the nation as a whole.

Of the 125 hospitals licensed by NCDHHS, three are closed. One of the 11 private psychiatric facilities was closed, and one required their clients be capable of self-care to be admitted. The psychiatric facility not providing acute care and the four closed

facilities were not surveyed. The remaining 131 hospitals were included in this study. Future references to hospitals assumes inclusion of the psychiatric facilities, unless stated otherwise.

Hospitals in NC include single hospitals and hospitals systems made up of two or more hospitals. A letter of invitation to participate in the study was sent to the Director of Staff Education at each licensed facility. The Director was asked to forward the survey link provided in the letter to the staff education individual who was responsible for the orientation of new graduate RNs for their hospital. This individual may be a staff member in the Director's hospital, or, if part of a hospital system, located in a centralized or regional education location. Even if there is centralized or regional orientation, surveying an individual involved with system staff orientation still achieved the desired result of surveying how nurses were oriented for all hospitals because the orientee nurses work in the individual hospitals.

Sample Size

The new graduate nurses were identified for study invitation from the NC Board of Nursing list of RNs currently licensed in NC. In the 2014-2015 academic year (the latest year that data are available) there were 3554 prelicensure RN graduates (82 diploma, 2103 associates, and 1369 bachelor's) (North Carolina Board of Nursing, 2016b). Based on minimal change from the prior year, it is anticipated that there will be approximately the same number of graduates in the 2015-2016 academic year. In 2015 86% of the NCLEX-RN candidates in NC passed the exam and 92% passed on the first attempt (North Carolina Board of Nursing, 2015). It was anticipated that between 86%

and 92% of the anticipated number of graduates (approximately 3500 nurses) will successfully pass the NCLEX-RN examination and become licensed to practice nursing between June 1, 2015 and May 31 resulting in an RN pool for this study between 3010 and 3220 potential participants.

The NC Board of Nursing list identified the date each nurse was first licensed in NC. It did not indicate when or where the nurse received the RN education that qualified them to apply for licensure in NC, nor did it identify whether the nurse had been previously licensed as an RN in another state. After filtering the list to select only nurses who were licensed for the first time between June 1, 2015 and May 31, 2016, had a NC mailing address, and a valid e-mail address, there were 6032 names remaining. Surveys were sent to the 6032 potential participants, and reminder messages with the study survey link were sent two and four weeks after the initial invitation. Screening questions were included at the beginning of the nurse survey to exclude all nurses who were educated outside of NC, were not working in NC, or who had completed their initial RN education prior to June 1, 2014.

At the time of the study, there were 85 prelicensure, RN nursing programs approved by the NC Board of Nursing (1 diploma, 57 associate degree, and 27 baccalaureate) (North Carolina Board of Nursing, 2016a). Two programs are approved for both associate and baccalaureate programs, and they were only surveyed once each. One program will not have students until January, 2017 and it was not surveyed. After obtaining the e-mail address of the faculty member responsible for the course where medication management was initially taught, a study invitation was sent to 82 potential

participants at prelicensure RN education programs. Reminder e-mails with a link to the study survey was sent two and four weeks after the initial invitation.

All of the 131 open acute care and psychiatric hospitals licensed by NCDHHS were invited to participate in this study, either as individual hospitals or as part of a hospital system, through a letter sent to the Director of Staff Education. There were 13 independent hospitals and 19 health systems in NC that use a variety of orientation schemes, e.g., individual hospital, regional, centralized. Every hospital that provided new graduate RN orientation was invited to participate, even if they are part of a larger system.

Because of the paucity of research on this topic it was difficult to estimate expected response rates. Many of the studies using survey methodology to investigate nurse perceptions of medication errors reported the number of participants, but not the response rate. Of the studies that reported response rates, they described rates from a low of 8.2% (Jones & Treiber, 2010) to a high of 100% (Unver et al., 2012). Nulty (2008) reviewed response rates reported in the literature for online and paper-based surveys. In all but one of the studies reviewed, response rates of online surveys were lower (average of 33%) than paper-based surveys (average of 56%). Two interventions were suggested as ways to boost response rates for the online surveys: repeat reminder e-mails and incentives for participants based on a lottery.

Since this study surveyed the entire population of each group, it was critical to maximize participation with the initial survey distribution because it was not possible to increase sample size at a later time. Although there have been mixed reports as to

whether monetary incentives improve response rates to online surveys (Doerfling, Kopec, Liang, & Esdaile, 2010; Pedersen & Nielsen, 2016; P. M. Wilson, Petticrew, Calnan, & Nazareth, 2010), one strategy that was used to encourage maximum participation in the proposed study was the opportunity for participants to provide their e-mail address to be entered in a random drawing for a chance to win one of eight \$25 Amazon gift certificates. In addition to the monetary incentive, each school of nursing and hospital/hospital system was contacted individually by telephone, e-mail, or mail to identify the most appropriate person to whom to send the survey and increase the chance of a response. Personal contact improved the likelihood of the survey being sent to the most appropriate person, and may have increased the response rate. Reminder e-mails were sent to everyone who received an e-mail survey invitation at two and four weeks after the initial survey was distributed to encourage anyone who had not yet responded to participate.

Human Subjects Protection

To ensure the protection of human subjects, the study was reviewed by the University of North Carolina at Greensboro Institutional Review Board (IRB) prior to the start of the study and determined to be exempt. The information form format provided by the Office of Research Integrity was used, and all recruitment materials, information forms, and survey questionnaires were reviewed by the IRB prior to survey distribution. Each participant was required to agree to the study information provided in the information form before they were allowed access to the survey.

Instruments

Data collection was accomplished using three electronic surveys created in Qualtrics (Version October 2016): a new graduate questionnaire, a nursing program questionnaire, and a hospital/hospital system staff education questionnaire (See Appendices A, B, and C for survey instruments.). The new graduate questionnaire was made up of three parts: the modified Gladstone scale (Mayo & Duncan, 2004), researcher-developed questions that ask the nurse to recall how they were taught medication management in school and reviewed in their orientation program, and a demographics section. The nursing program and hospital questionnaires were similar and included two sections: demographics about the organization, and questions about how medication management was taught in the prelicensure program or reviewed during orientation. Only organizational data were gathered in the surveys for the nursing programs or hospitals. All the questions about how medication management was taught or reviewed were linked across surveys with only slight wording changes to fit the audience and to be grammatically correct.

Nurse Questionnaire

The nurse questionnaire consisted of 48 items divided into three parts, which contribute data to answering research questions 1 through 11, 15, 17, and 18. The 48 questions included three screening questions to ensure the respondent met the inclusion criteria, 14 items from the modified Gladstone scale, five questions about academic education, 13 questions about workplace orientation and policies, 15 demographic items, and one final item that solicited any general comments the respondent cared to make.

Three screening questions were presented to participants prior to accessing the survey to ensure the respondent met the inclusion criteria.

The original Gladstone scale was developed by Jill Gladstone for use in a study of the factors related to medication errors in a district hospital in the United Kingdom (Gladstone, 1995). The study included a questionnaire for nurses, a different questionnaire for nurse managers, nurse interviews, and review of medication error incident reports. The original Gladstone nurse questionnaire was designed “with the purpose of establishing nurses’ perceptions as to the causes of drug errors, their views on the reporting on drug errors and their training and updating for the task” (Gladstone, 1995, p. 630). The first two parts of the Gladstone nurse questionnaire were extracted by other researchers, identified as the modified Gladstone scale, and used in studies of medication errors in several countries (Mayo & Duncan, 2004; Mrayyan, 2012; Mrayyan & Al-Atiyyat, 2011; Mrayyan, Shishani, & Al-Faouri, 2007; Osborne et al., 1999; Unver et al., 2012). Content validity of the instrument based on a review by experts or pilot studies was reported in several studies (Gladstone, 1995; Mrayyan, 2012; Mrayyan et al., 2007; Osborne et al., 1999). Reliability information was not provided in the initial study, but subsequent studies have reported reliability of 0.78 using the test-retest method (Osborne et al., 1999), a Cronbach’s alpha of 0.65 (with scenarios excluded) (Mrayyan & Al-Atiyyat, 2011), and a Cronbach’s alpha of 0.61 (English version administered in Jordan) (Mrayyan, 2012). It is not clear how the Cronbach’s alpha was calculated because the scale addressed multiple constructs, there was no description of which

questions were associated with a construct, and there was not a sum score noted in the literature.

The modified Gladstone scale included one rank-order question, with 10 statements; six brief scenarios, with three dichotomous (yes/no) responses for each scenario; five items with statements and 4-point Likert-type responses (Strongly agree, Somewhat agree, Somewhat disagree, Strongly disagree); and two questions using sliders for the participant to indicate the number of errors they remember making and their estimate of the percentage of drug errors reported on incident reports. The five items with Likert-type responses had dichotomous (yes/no) responses in the original instrument. Since there were only five items, and the variability of dichotomous answers is low (DeVellis, 2003), it would have been difficult to find meaningful variation in the responses. In an effort to extract the most information from the data, the five questions were modified to Likert-style questions with four response options: Strongly agree, Somewhat agree, Somewhat disagree, and Strongly disagree. Using two positive and two negative response options gave the researcher the ability to merge the data into negative and positive responses that were compared to previous findings. The item's statements were also slightly modified to change them from questions to statements and were presented as a matrix table. As much of the original wording was retained as possible.

Following the modified Gladstone scale, the second part of the nurse questionnaire consisted of 18 researcher-developed questions designed to gather foundational data about nurse experiences related to learning medication management during their education and orientation programs. The academic education questions

included three Likert-type questions that asked the nurse to indicate how effective their experiences had been when learning medication management related to the courses they took (eight courses plus “Other”), the teaching strategies used (eight strategies plus “Other”), and the activities and equipment used (15 activities and equipment plus “Other”). The responses for these questions included Very effective, Effective, Neutral, Ineffective, Very Ineffective, and Didn’t take/NA. One multiple choice question was asked about the setting of where medication management was taught (four locations plus “Other”). The academic education questions concluded with one open-ended question that invited the participants to share what they thought could have been done differently in their nursing education program to better prepare them to safely manage medications.

In the workplace orientation section, the initial dichotomous question (yes/no) asked whether the participants had participated in a transition to practice (TTP) program specifically designed for new graduate RNs. If they responded yes, they received a follow-up question asking them to indicate their TTP program length. If they answered no, they were presented with a question asking the length of their orientation. The next three questions were almost identical to the three Likert-type questions asked in the academic education section (courses, teaching strategies, and activities and equipment) except that “reviews of these topics” was substituted for “these courses.” The same six response options were provided for these three questions. One open-ended question solicited input from the participants on how their workplace orientation could have been done differently to better prepare them for safe medication management. Five multiple choice questions asked the respondents to identify the technology available in their

workplace for medication management, whether there are policies related to distractions or interruptions in medication administration, and if so whether they thought they were effective, whether their organization had an official definition of a medication error, and how their medication management competency was assessed during their orientation. Any participant who responded that their organization had an official medication error definition was also presented with a text entry question and asked to copy and paste the definition into the survey.

The final section of questionnaire collected demographic information using 13 multiple choice questions and two text entry items questions that required numerical responses. After the demographic questions, the survey concluded with a text entry question that provided an opportunity for the participant to share any additional information they wanted to share related to their experiences with learning safe medication management.

At the end of each survey the participants were given the opportunity to indicate whether they wanted to provide their e-mail address to be entered in a random drawing for one of eight \$25 Amazon gift cards, or to receive a summary of the research findings. If they indicated they wished to participate in the drawing or receive the summary, they were transferred to a separate survey to collect contact information so that their e-mail address was not associated with their survey responses.

Nursing Education Program Questionnaire

The nursing education program questionnaire consisted of 13 items divided into two parts. Demographic information was collected in the first part using seven multiple

choice items. Six questions asked for descriptive information about the organization and one queried whether the program had an official medication error definition. If the participant responded positively to the error definition question, an additional text entry question was presented asking them to copy and paste the definition into the provided box. The second part of the survey consisted of five multiple-choice items concerning educational practices related to teaching medication management to prelicensure RN students and competency assessment. Three of these questions asked about the same items as the three Likert-type questions the nurses were asked in the academic education section (courses, teaching strategies, and activities and equipment), except the educator participants only needed to indicate whether they provided the course or used the teaching strategy, activity or equipment. One final text entry question gave the participant an opportunity to share any other information they cared to provide related to how they educated prelicensure RNs students for safe medication management. The participants were also given the opportunity to be entered in the incentive drawing or receive a summary of the study findings using the same procedure as for the nurse survey. Data from this survey contributed to answering research questions 12 through 15.

Hospital/Hospital System Orientation Questionnaire

Prior to accessing the hospital orientation survey all participants were asked one screening question about whether their organization hired new graduate RNs. If they answered that they did, access was opened to the 23 question survey. The first seven multiple choice questions gathered demographic information about the organization. The

next nine questions asked about orientation practices, including the availability of a formal transition to practice (TTP) program for new graduate RNs, length of orientation, and the content and teaching methods used to review information about safe medication management. Three of these questions asked about the same items as the three Likert-type questions the nurses were asked in the workplace orientation section (review topics, teaching strategies, and activities and equipment), except the staff education participants only needed to indicate whether they provided information on the review topic or used the teaching strategy, activity, or equipment. Five multiple choice questions were related to how medication management competency was assessed, the medication-related technology that was available in the organization, policies on distractions or interruptions during RN medication administration, including whether these policies were effective, and whether the organization had an official definition of a medication error. If the participant responded that their organization had an official medication error definition, one additional text entry item was presented and they were asked to copy and paste the definition into the box provided. The survey concluded with one text entry question that invited the participant to share any additional information they wished to related to how new graduate RN employees were prepared to safely manage medications during their organizations orientation process. At the end of the survey the participants were given the opportunity to be entered in the incentive drawing or receive a summary of the study findings using the same procedure as for the nurse survey.

Nine of the 16 items in the second part of the survey were very similar or identical to items on the new graduate and education program surveys to allow for comparison

across the surveys. Answers to research questions 16, 17, and 18 were acquired using data from this survey.

Survey Procedure

Prior to survey distribution, each survey was reviewed by three nurses known to the researcher with knowledge and experience related to the respective participant populations: three RNs active in clinical practice, three nurse educators, and three nurses working in hospital staff development positions. The reviewers were all acquaintances of the researcher and were excluded from study participation. The three clinical nurses were RNs licensed in the previous two to three years. Their education and orientation experiences were recent, but not recent enough for them to be included in the study participant pool. The nurse educator and staff education reviewers were familiar with the education and orientation processes that occur related to new graduate preparation and orientation for safe medication administration, but they were not responsible for those activities. The educators were excluded from the participant pool and the staff education personnel were asked to recuse themselves from completing the survey if asked to do so by their supervisor. The reviewers assessed question clarity, evaluated face validity, appraised content, and judged the time required for the completion of each survey. Adjustments were made to question directions and wording based on reviewer suggestions.

The study surveys were distributed via e-mail using a copy of the Qualtrics (Version October 2016) software licensed to the University of North Carolina at Greensboro. Each nurse or nurse educator invited to participate received a personalized,

one-time use link that was active for six weeks. The invitation letters for hospital staff educators included a response link for participation. The survey used anonymized responses which removed the participant's IP address and location data from the results.

Each survey began with an Information Form explaining the study and that participation is voluntary. Each participant was required to check a box indicating they had read the information and either agreed or declined to participate. Only if they indicate they agreed to participate was the survey made available to them. A reminder e-mail was sent to nurse and nurse educator participants two weeks and four weeks after survey distribution.

The participants moved through the survey one question at a time and were allowed to move forward and backward in the survey. Data were maintained in the password protected Qualtrics system, or the researcher's password protected computer, and were only available to those directly involved with the research study. To ensure anonymity no personally identifiable data were collected on any of the surveys. There was a possibility that a program administrator from Information Technology Services at the University may have access to the data while providing technology assistance or maintenance. All individuals with administrative access to Qualtrics data had completed appropriate human subjects protection training and the training was on file with the University Office of Research Integrity.

Two events occurred during data collection that may have negatively impacted participant response. On October 21, 2016, a Distributed Denial of Service (DDoS) attack affected the company that hosts the Qualtrics platform and blocked any access to

the study surveys. This attack affected large portions of the US and some countries in the European Union for approximately 12 hours. The attack occurred during the same time as the first reminder messages were sent to the potential nurse participants. The original invitations and reminders were sent out over three days to reduce the likelihood of blocking by e-mail providers, and a notable drop in responses was noted between day one and day three of the reminder messages.

The second event that impacted data collection was Hurricane Matthew, which seriously affected one third to one half of NC. A large portion of the state was flooded and without power for as much as a week. Most of the universities and community colleges in the eastern half of the state were closed. This emergency disrupted the lives of all three groups of potential participants and reduced access to the surveys, which in turn most likely impacted response rates. The situation also made it especially difficult to contact schools and access nurse educator participants, thus requiring data collection to be extended by a month.

Data Analyses

Data were collected using Qualtrics (Version October 2016) software and, after appropriate review and cleaning, were analyzed using the Statistical Packages for the Social Sciences (SPSS), Version 23 (International Business Machines Corp, 2015). Participant characteristics and items were explored using descriptive statistics such as frequency distributions, contingency tables, percentages, modes, means, ranges, and standard deviations, as appropriate for the data level.

Data Analyses by Specific Aims

The data analysis was guided by and organized based on the concepts of the theory of situated cognition. The following specific aims and research questions were addressed:

1. Identify new graduate RN perceptions about medication error causes, identification, and reporting.

Q1: What are new graduate RN perceptions about causes of medication errors?

A frequency distribution with percentages was used to analyze what new nurses perceived as the causes of medication errors.

Q2: What do new graduate RNs identify as a medication error?

The scenarios nurses identified as medication errors were analyzed using a frequency distribution with percentages.

Q3: What medication errors do new graduate RNs believe should be reported to the patient's physician?

Data on what nurses believe should be reported to the physician as a medication error were evaluated using a frequency distribution with percentages.

Q4: What medication errors do new graduate RNs believe should be reported on an incident report?

A frequency distribution with percentages was used to analyze data on what medication errors nurses believe should be reported on an incident report.

Q5: What are new graduate RN perceptions about reporting medication errors?

A frequency distribution with percentages was used to evaluate nurse perceptions about what percentage of errors are actually reported on incident reports.

Q6: Do new graduate RN perceptions of medication errors differ based on demographic characteristics?

Contingency tables were used to identify relationships between demographic characteristics (gender, age group, RN degree, work unit) and perceptions about medication errors (error identification, error reporting, error causes).

2. Examine prelicensure nursing education program experiences that new graduate RNs report were effective in preparing them to safely manage medications and what additional experiences would have made them better prepared.

Q7: What do new graduate RNs report were the courses, teaching strategies, activities, or equipment used in their prelicensure nursing programs that effectively prepared them to safely manage medications (prepare, administer, and monitor)?

Frequency tables were created to identify which experiences the new graduate RNs identified as very effective, effective, neutral, ineffective, or not used/NA.

Q8: What do new graduate RNs think could have been done differently in their nursing education program to better prepare them to safely manage medications?

Text responses were extracted and analyzed for recurring themes and clustered into word or phrase groupings with descriptive statements.

Q9: What do new graduate RNs report were the reviews topics, settings, teaching strategies, activities, or equipment used in their workplace orientation that effectively prepared them to safely manage medications (prepare, administer, and monitor)?

Frequency tables with percentages were computed to identify which experiences the new graduate RNs identified as very effective, effective, neutral, ineffective, or not used/NA.

Q10: What do new graduate RNs think could have been done differently in their workplace orientation to better prepare them to safely manage medications?

Text responses were extracted and analyzed for recurring themes and clustered into word or phrase groupings with descriptive statements.

Q11: Do nurse-reported effective preparation experiences differ based on demographic characteristics?

Contingency tables with percentages were created to identify relationships between demographic characteristics (gender, age group, RN degree, work unit) and perceptions about effective preparation experiences (courses, teaching strategies, and activities and equipment).

3. Describe how new graduate RNs are being prepared to safely administer medications in prelicensure programs in NC.

Q12: Where in the nursing curriculum is new medication management content most frequently taught?

A frequency distribution with percentages was developed to identify in which courses new medication management material was taught. A multiple response set was also developed and analyzed to identify the percentage of organizations using each type of course.

Q13: What teaching strategies are most commonly used to teach safe medication management?

A frequency distribution with percentages was created to identify the teaching strategies used to teach safe medication management. A multiple response set was also developed and analyzed to identify the percentage of organizations using each type of strategy.

Q14: What activities and equipment are most frequently used to teach safe medication management?

A frequency distribution with percentages was generated to identify the activities and equipment used to teach safe medication management. A multiple response set was also developed and analyzed to identify the percentage of organizations using each type of activity or equipment.

Q15: How do the classes, teaching strategies, activities, and equipment used to teach medication management in nursing programs compare to the effective preparation experiences reported by new graduate RNs?

The total number of nurse responses of effective or very effective for each course, teaching strategy, activity, or equipment was calculated and the number who indicated they did not take/use the item or NA was subtracted from the total. The result was

divided by the number of participants who completed the question and provided the percentage who identified the experience as effective. This percentage was compared to the percentage of programs who reported using each course, teaching strategy, activity or equipment to identify any relationships.

4. Describe how new graduate RN workplace orientation ensures competency to safely manage medications.

Q16: What content reviews, teaching strategies, activities, or equipment are used during new graduate RN workplace orientation to review safe medication management?

Frequency distributions with percentages were created to identify the experiences used to review medication management in workplace orientation programs.

Q17: How are new graduate RNs evaluated to determine medication management competency during workplace orientation?

A frequency table with percentages was used to depict how medication competency was determined, as reported by staff development employees and nurses.

Q18: How do the content reviews, teaching strategies, activities, and equipment used to review safe medication management during workplace orientation programs compare to the effective orientation experiences reported by new graduate RNs?

The total number of nurse responses of effective or very effective for each review topic, teaching strategy, activity, or equipment was calculated and the number who indicated they did not take/use the item or NA was subtracted from the total. The result

was divided by the number of participants who completed the question and provided the percentage who identified the experience as effective. This percentage was compared to the percentage of hospitals/hospital systems who reported using each course, teaching strategy, activity or equipment to identify any relationships.

Summary

There is a significant problem with medication errors in the US health system. Many of the error causes have been identified, but they have been addressed in a disjointed, patchwork fashion. It is the belief of the author that significant progress toward error reduction will only take place when all the elements in the health care system and the people functioning within the system are accounted for in the solution. The theory of situated cognition presents a model for understanding the interactions of all the interconnected parts, and identifying the most effective ways to intervene at both the system and individual levels.

Although there is a large body of knowledge related to the results of errors, such as causes, frequency, and precipitating factors, there is still a large gap in what is known about current educational practices to prepare health care workers to safely manage medications and how teaching methods are impacting on patient outcomes. To begin to fill this gap, this study investigated how new nurses were prepared to safely manage medications. Specifically, the purpose of this study was to identify new graduate RN perceptions about medication error causes, associated behaviors, and error prevention education, and to determine how new graduate RNs were being prepared for safe medication management during prelicensure nursing education, and workplace

orientations. This exploratory study provides foundational data identifying new graduate nurse beliefs about medication errors, what they found were effective educational experiences related to learning safe medication management, and how those experiences related to what prelicensure nursing education and workplace orientation programs reported they were providing.

CHAPTER IV

RESULTS

The purpose of this study was to identify new graduate registered nurse (RN) perceptions about medication error causes, associated behaviors, and error prevention education, as well as how new graduate RNs are being prepared for safe medication management during prelicensure nursing education, and workplace orientations. This chapter presents the results of the analysis of data from the three study surveys: new graduate RNs, schools of nursing, and hospital staff education. The sample will be described in detail and the results will be presented according to the research aims and questions for both the quantitative findings and responses to the qualitative open-ended questions.

Sample

Study participants included three different groups. The first group consisted of all RNs who graduated from a North Carolina (NC) Board of Nursing approved RN education program in NC after June 1, 2014, were initially licensed to practice nursing in NC between June 1, 2015 and May 31, 2016, and were working in an acute care setting at the time of the survey. The second group of participants included representatives from nursing programs in NC who were approved by the NC Board of Nursing to provide prelicensure RN education and who had students enrolled at the time of the study. The

third group was made up of representatives from acute care hospitals or hospital systems licensed by the NC Department of Health and Human Services and operating at the time of the study.

New Graduate RNs

A listing of all RNs licensed in NC as of 8/15/2016 was obtained from the NC Board of Nursing. At that time there were 130,480 RNs with a current NC license. Of these nurses 8629 were initially licensed in NC during the inclusion dates. This number was much higher than the anticipated 3500 based on the NC Board of Nursing graduation statistics for the 2014-2015 academic year (North Carolina Board of Nursing, 2016a). It was not possible to further refine the pool of participants because the NC Board of Nursing listing did not provide work location, the state where the nurse was educated, or whether the nurse was previously licensed in another state. All nurses on the NC Board of Nursing listing with a NC address, a current e-mail address, and who were licensed in the inclusion time period (6032) were e-mailed an invitation to participate in the study. Of those invited, 428 responded and agreed to participate for a 7.1% response rate. There were 238 participants excluded based on responses to screening questions because they did not meet inclusion criteria: did not receive their initial RN education from a NC prelicensure nursing education program (197), graduated from their initial RN education before June 1, 2014 (9), were not currently working as an RN in an acute care setting in NC (28), or were licensed before June 1, 2015 or after May 31, 2016 (4). An additional 59 individuals either did not complete the screening questions or did not answer any survey questions. A total of 131 nurses participated in the study. Thirty-seven

participants did not respond to all the survey items, but the data for all completed items were used. The number of responses included is identified on each table.

Nursing Education Programs

There were 85 NC Board of Nursing approved prelicensure RN education programs in NC at the time of this study. These programs included 1 diploma, 57 associate degree, and 27 baccalaureate programs. All programs were contacted by telephone and/or e-mail to identify the faculty member most knowledgeable about how medication management was taught to prelicensure RN students in their program. An e-mail invitation was sent to one faculty member at each school. In two instances the program identified that they had multiple campuses. Only one faculty member was surveyed in both these instances because the contacts stated all the campuses used the same curriculum and the same faculty. There were two institutions where both associate and baccalaureate programs were approved by the NC Board of Nursing separately. These programs were only surveyed once, and were included in the total number of programs once (one as an associate program and one as a baccalaureate program). One program reported they were a new program and were not accepting students until January, 2017. A total of 82 programs were invited to participate and 35 respondents completed the study for a response rate of 42.7%.

Hospitals/Hospital Systems

Invitation letters were mailed to the Director of Staff Education at each of the 131 acute care hospitals in NC licensed by the NC Department of Health and Human Resources. The instructions in the letter requested that the individual responsible for new

graduate education at their facility be asked to complete the survey, whether the orientation was carried out at their facility, or centrally/regionally if they are part of a hospital system. There were 21 responses to the survey invitation, with 20 individuals completing the survey and representing 6 independent hospitals and 14 hospital systems.

To protect participant anonymity, respondents who were employed by a hospital system were not asked to provide the number of hospitals in their system. An estimate of the minimum number of hospitals who participated in this study was developed based on the number of individual hospitals identified (6) plus the number of different types of hospitals for each participant from a multi-hospital system (22). A total of at least 28 of 131 facilities were represented resulting in at least a 21.4% response rate. This number was probably higher because some systems include multiple hospitals of the same type.

Preliminary Examination of Data

Data were collected using Qualtrics (Version October 2016) survey software and data analysis was completed using the Statistical Package for the Social Sciences (SPSS) (IBM Corp., Amonk, NY). Three surveys were used for data collection; one for each participant group. All data were visually inspected and frequencies were calculated to assess for missing and extreme values. One extreme value was noted in a hospital response related to the number of staff education employees at their facility. This response was treated as missing. There was a notable issue with missing data on the nurse demographic items. The actual number of responses are listed in this chapter with the demographic results. There were also two occurrences of missing data on the report

of full time faculty on the nursing school survey. Responses to open-ended questions were printed and assessed for recurring phrases and themes.

New Graduate RN Demographic Characteristics

The RN sample included nurses who had been licensed for approximately one year. Almost 60% were between the ages of 20 and 30 years, with participant ages ranging from 22 to 59. A large majority were female (86.3%), non-Hispanic (96.8%), and white (81.3%). All participants reported English as their preferred language. Most of the participants had an associate degree (52.6%) and worked full time (97.9%) on night shift (47.4%). A wide variety of work units were reported with the most frequent being medical/surgical (including specialty units: orthopedics, cardiology, neurology, and oncology) (37.9%), critical care (20.0%), and emergency department (14.7%). Table 1 provides detailed RN demographic information.

Table 1

Demographic Characteristics of New Graduate RN Participants^a

Characteristic	<i>n</i>	%
Age		
20-29	56	58.9
30-39	24	25.3
40-49	10	10.5
50-59	2	2.1
Gender		
Female	82	86.3
Male	11	11.6
Other/No answer	2	2.1

Characteristic	<i>n</i>	%
Ethnicity		
Non-Hispanic	91	96.8
Hispanic/Latino	3	3.2
Race		
White	78	81.3
Black/African American	16	16.7
Other	2	2.1
Initial RN degree		
Diploma	1	1.1
Associate	50	52.6
Baccalaureate	44	46.3
Employment status		
Full time (≥ 36 hr/wk)	93	97.9
Part time (<36 hr/wk)	2	2.1
Average hours worked per week		
10-19	1	1.1
20-29	1	1.1
30-39	55	57.9
40-50	38	40.0
Primary shift		
Days (8 or 12 hrs)	29	30.5
Evening (8 hrs)	3	3.2
Nights (8 or 12 hrs)	45	47.4
Rotate	18	18.9
Unit type		
Medical/Surgical	36	37.9
Pediatric	3	3.2
OB/GYN	4	4.2
Mental health/Psychiatric	3	3.2
Rehabilitation (inpatient)	1	1.1
Step-down	12	12.6
Critical care	19	20.0
Emergency department	14	14.7
Operating room	1	1.1
Outpatient surgical or procedure center	2	2.1

^a*n* = 95

Nursing Education Program Demographic Characteristics

Responses were received from nurse educators at 35 nursing schools. The majority of these schools were public institutions (80.0%), associate degree programs (62.9%), and their courses were primarily provided face-to-face (88.6%). The number of faculty varied widely between programs with baccalaureate programs generally having more full and part time faculty. Additional demographic details are presented in Table 2 below.

Table 2

Demographic Characteristics of School of Nursing Participants^a

Organization type	<i>n</i>	%
Public	28	80.0
Private non-profit	5	14.3
Private for-profit	2	5.7
Majority (>50%) of courses in program	<i>n</i>	%
Face-to-face	31	88.6
Hybrid or blended (face-to-face and online within one course)	4	11.4
Online	0	0.0

Programs by Degree	<i>n</i>	%	Full Time Faculty	Full Time Min/Max	Part Time Faculty	Part Time Min/Max
			Mean (SD)		Mean (SD)	
Associate	22	62.9	9.90 (5.3)	4 -25	5.95 (7.1)	0 - 24
Baccalaureate	12	34.3	32.27 (35.2)	4 - 100	10.75 (13.9)	0 - 50
Diploma	1	2.91	15 (n/a)	15	0	0

^a*n* = 35

Hospital/Hospital System Demographic Characteristics

All hospital representatives reported that their organizations hired new graduate RNs. The majority of organizations in the study were non-profit (85.0%), with an acute care clinical focus (95%). The hospitals spanned a wide range of types, with community hospitals being the most frequent (65.0%). Most of the participants represented hospital systems (70%), and those in hospital systems most frequently reported utilizing a centralized method of orientation for their new graduate RN employees (42.9%). A majority of organizations offered new graduates a specialized transition to practice orientation program (TTP) (80%), but the length of the programs varied widely from one to two months to more than 12 months. Four organizations reported that they did not provide new graduate RNs with a TTP program. The new graduate RN non-TTP orientation programs were reported to last either 5 to 6 weeks (1), 8 to 9 weeks (1) or 12 to 13 weeks (2). Two of the organizations were independent hospitals (5-6 week and 12-13 week orientations), and two were part of hospital systems. The transition to practice programs were notably longer than traditional orientation programs for experienced RNs, which were reported to last from less than 1 week to up to 12 weeks, with 50% of the participants reporting between 4 and 7 weeks. See Table 3, Table 4 and Figure 2 for additional hospital demographic details.

Table 3

Demographic Characteristics of Hospitals/Hospital Systems^a

	<i>n</i>	%
Hospital organization type		
Non-profit	17	85.0
For-profit	3	15.0
Public (government)	0	0.0
Clinical foci of facilities		
Acute care	19	95.0
Psychiatric	5	25.0
Rehabilitation	4	20.0
Long-term acute care	3	15.0
Types of hospitals	<i>n</i>	(%)
Community hospital	13	65.0
Academic/teaching hospital	4	20.0
Critical access hospital	4	20.0
Rural hospital	4	20.0
Specialty hospital	2	10.0
Metropolitan, non-academic hospital	1	5.0
Hospital Organization Structure	<i>n</i>	%
Hospital system	14	70.0
Independent hospital	6	30.0
Hospital System Orientation Locations	<i>n</i>	%
Orientation provided at one central location	6	42.9
Some orientation provided centrally and some at individual hospitals	5	35.7
Orientation provided at each individual hospital	3	21.4

^a*n* = 20

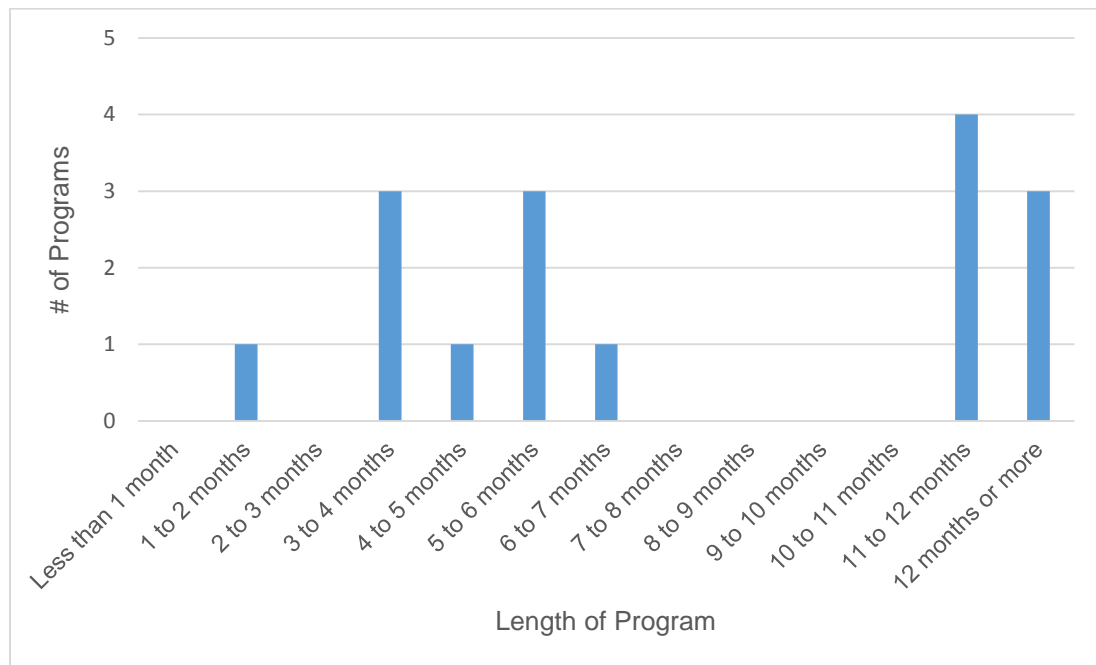
Table 4

Hospital Reported Orientation Lengths

	Mean (SD)	Min	Max
Transition to practice orientation length (months)	8.19 (4.0)	2	13
Experienced RN orientation length (weeks)	7.25 (3.4)	1	12

Figure 2

Length of New Graduate Transition to Practice Programs



Descriptive Characteristics of the Instruments

Three surveys were used to collect data from the three groups of participants: nurses, schools of nursing, and hospitals. The characteristics of each survey are described in Chapter 3. The surveys identified data related to nurse perceptions about medication errors and how nurses are prepared to safely manage medications in their

education and workplace orientation programs. Each item was linked to one or more research questions.

Findings Related to Specific Aims and Research Questions

Specific Aim 1

Identify new graduate RN perceptions about medication error causes, identification, and reporting.

Research question 1. What are new graduate RN perceptions about causes of medication errors?

Nurse perceptions about causes of medication errors was measured by one item on the modified Gladstone scale. The participants were asked to rank order 10 potential causes of medication errors, with the most frequent cause of error identified as 1 and the least frequent cause as 10. Means and standard deviations were calculated and are presented in Table 5.

Table 5

Ranked Causes of Medication Errors^a

	Mean	Std. Deviation
Drug errors occur when nurses are distracted by patients, co-workers, or events on the unit.	2.40	1.908
Drug errors occur when nurses are tired and exhausted.	3.14	2.176
Drug errors occur when the nurse fails to check the patient's name band with the Medication Administration Record (MAR)	4.58	2.731
Drug errors occur when there is confusion between two drugs with similar names.	5.24	1.954
Drug errors occur when the nurse miscalculates the dose.	5.26	2.231
Drug errors occur when the nurse sets up or adjusts an infusion device incorrectly.	5.36	2.181
Drug errors occur when the physician prescribes the wrong dose.	5.81	2.324
Drug errors occur when nurses are confused by the different types and functions of infusion devices.	7.28	2.009
Drug errors occur when the physician's writing on the doctor's order form is difficult to read or illegible.	7.92	2.739
Drug errors occur when medication labels/packaging are of poor quality or are damaged.	7.97	2.229

Note: *Ranking: 1 indicates most frequent cause, 10 indicates least frequent cause

^a*n* = 131

Research question 2. What do new graduate RNs identify as a medication error?

Identification of medication errors was based on the responses to six scenarios from the modified Gladstone scale. The frequencies of “Yes” and “No” responses were

calculated for each scenario. Late administration of medications was inconsistently identified as an error depending on the situation described. Discrepancy in an intravenous infusion rate was overwhelmingly identified as an error (97.8%). Scenarios that required clinical decision-making, such as whether to administer a medication to a sleeping patient, resulted in a fairly even distribution of positive and negative responses. See Table 6 for additional information.

Research question 3. What medication errors do new graduate RNs believe should be reported to the patient's physician?

The six scenarios from the modified Gladstone scale were used to evaluate what medication errors nurses believed should be reported to a patient's physician. A frequency distribution with percentages was calculated. The majority of participants thought the situations described in all scenarios warranted reporting to the physician, even when they overwhelmingly reported that the scenario did not indicate an error. See Table 6 for additional details.

Research question 4. What medication errors do new graduate RNs believe should be reported on an incident report?

The medication errors nurses believed should be reported on incident reports were based on participant responses to the six scenarios in the modified Gladstone scale. An incident report was indicated as being needed by a majority of the respondents only for a late dose of a postoperative antibiotic (60.5%) and an incorrect intravenous infusion rate (91.0%). These were also the only two scenarios where a majority of the participants

indicated the situations presented constituted errors, should be reported to the physician, and an incident report was necessary. Table 6 presents additional information.

Table 6

Classifying and Reporting Medication Errors

Scenario 1: A patient misses his midday dose of oral ampicillin because he was in X-ray for 3 hours.					
	<u>Yes</u>	<u>n</u>	<u>No</u>	<u>n</u>	<u>Total</u>
Medication error	25.2%	34	74.8%	101	135
Notify physician	76.3%	103	23.7%	32	135
Incident report necessary	19.3%	26	80.7%	109	135
Scenario 2: Four patients in a busy surgical unit receive their 6 PM dose of antibiotics 4 hours late.					
	<u>Yes</u>	<u>n</u>	<u>No</u>	<u>n</u>	<u>Total</u>
Medication error	71.9%	97	28.2%	38	135
Notify physician	74.1%	100	25.9%	35	135
Incident report necessary	60.5%	81	39.6%	53	134
Scenario 3: A patient receiving TPN feeding via an infusion pump is given 200 mL/hr instead of the correct rate of 125 mL/hr for the first 3 hours of the 24 hr. infusion. The pump was reset to the correct rate after the change of shift at 7 AM when the oncoming nurse realized that the pump was set at the incorrect rate.					
	<u>Yes</u>	<u>n</u>	<u>No</u>	<u>n</u>	<u>Total</u>
Medication error	97.8%	131	2.2%	3	134
Notify physician	94.0%	126	6.0%	8	134
Incident report necessary	91.0%	122	9.0%	12	134
Scenario 4: A patient admitted with status asthmaticus at 2 AM is prescribed albuterol (Ventolin) nebulizers every 4 hr. The nurse omits the 6 AM dose because the patient is asleep.					
	<u>Yes</u>	<u>n</u>	<u>No</u>	<u>n</u>	<u>Total</u>
Medication error	57.6%	76	42.4%	56	132
Notify physician	66.7%	88	33.3%	44	132
Incident report necessary	48.5%	64	51.5%	68	132

Scenario 5: A physician orders oxycodone hydrochloride and acetaminophen (Percocet) 1-2 tabs for post-operation pain every 4 hr. At 4 PM the patient complains of pain, requests 1 pill, and is medicated. At 6:30 PM the patient requests a second pain pill. The nurse administers the pill.

	<u>Yes</u>	<u>n</u>	<u>No</u>	<u>n</u>	<u>Total</u>
Medication error	64.1%	84	35.9%	47	131
Notify physician	55.7%	73	44.3%	58	131
Incident report necessary	48.1%	63	51.9%	68	131

Scenario 6: A patient is receiving a routine 9 AM dose of digoxin every day.

Yesterday's digoxin level was 1.8 (the high side of normal). A digoxin level was drawn at 6 AM today. At 9 AM the nurse holds the digoxin because the lab value is not available yet.

	<u>Yes</u>	<u>n</u>	<u>No</u>	<u>n</u>	<u>Total</u>
Medication error	8.5%	11	91.5%	118	129
Notify physician	62.8%	81	37.2%	48	129
Incident report necessary	10.1%	13	89.9%	116	129

Research question 5. What are new graduate RN perceptions about reporting medication errors?

Nurse perceptions about reporting medication errors were measured using five questions from the modified Gladstone scale. Response frequencies with percentages were calculated. A large percentage of the participants reported that they either Strongly or Somewhat Agreed that they knew what constituted a medication error (92.7%), were sure when to report an error using an incident report (83.6%), believed that some medication errors were not reported by others because of fear of the reactions of others (89.4%), and would always report an error even if they did not think it was serious enough to report (78.9%). Only one quarter of the respondents either Strongly or Somewhat Agreed that they might not report a medication error because of a fear of disciplinary action (26.0%).

Research question 6. Do new graduate RN perceptions of the medication errors differ based on demographic characteristics?

Four questions from the modified Gladstone scale were used to identify RN perceptions about medication errors and error reporting. The results were combined in a contingency table to identify relationships with selected demographic characteristics (gender, age group, RN degree, and work unit). Males and females were equally sure in their knowledge of what constitutes a medication error (males 90.9%, females 91.4%), but males were more confident that they knew when to report a medication error on an incident report than females (males 100%, females 84.2%). Only females responded that they might not be sure when to use an incident report (15.9%). Both males and females reported that they thought some medication errors were not reported because of a fear of the reaction by a nurse manager or coworker (males 90.9%, females 86.6%), but a fear of disciplinary action or loss of job would not keep a majority of the participants from reporting an error (males 90.9%, females 70.7%). Notably, unlike males (9.1%), almost one third of the females reported that they might not report a medication error because of a fear of disciplinary action (29.2%).

When analyzing the data related to nurse perceptions of medication errors and error reporting by age group it should be noted that data are only available for two nurses in the 50-59 years age group. Because of the lack of results for this age group, the generalizability of the data is questionable. Comparison of the 50-59 year age group data with other age groups should be made with this in mind.

The youngest (20-29) and oldest (50-59) age groups reported the most confidence in their knowledge of what constitutes a medication error, 96.5% and 100% respectively. The two middle age groups, 30-39 (83.4%) and 40-49 years (80.0%), were almost as confident, but a markedly large number in the 40-49 year old group (20%) indicated they were not always sure what constituted a medication error. The youngest nurses were the least confident in knowing when to report an error on an incident report (85.7%) and the oldest nurses were the most confident (100%). The 30-39 year old nurses felt the most strongly that some medication errors are not reported because of the possible reaction by nurse managers or co-workers (54.2% Strongly agree), but this group also had the most who disagreed that this was the case (25%). The two oldest groups had a 100% response that some medication errors were not reported because of a possible negative response. Despite being very sure that not all errors were being reported, the majority of all age groups responded that a fear of disciplinary action or possible loss of their job would not deter them from reporting their own medication error. The 50-59 age group was the most sure (100%), followed by the 20-29 age group (75%). Less confidence was indicated by the two middle age groups where 30% or more agreed that they might not report an error due to a fear of disciplinary action.

Table 7

New Graduate RN Perceptions about Medication Errors and Error Reporting by Age Groups

		Age Groups			
		20-29 <i>n</i> (% within group)	30-39 <i>n</i> (% within group)	40-49 <i>n</i> (% within group)	50-59 <i>n</i> (% within group)
I am usually sure what constitutes a medication error.	Strongly agree	9 (16.1)	4 (16.7)	2 (20.0)	0
	Somewhat agree	45 (80.4)	16 (66.7)	6 (60.0)	2 (100.0)
	Somewhat disagree	2 (3.6)	2 (8.3)	2 (20.0)	0
	Strongly disagree	0	2 (8.3)	0	0
I am usually sure when a medication error should be reported using an incident report.	Strongly agree	19 (33.9)	5 (20.8)	2 (20.0)	0
	Somewhat agree	29 (51.8)	16 (66.7)	6 (60.0)	2 (100)
	Somewhat disagree	8 (14.3)	3 (12.5)	2 (20.0)	0
	Strongly disagree	0	0	0	0
Some medication errors are not reported because nurses are afraid of the reaction they will receive from the nurse manager or coworkers.	Strongly agree	25 (44.6)	13 (54.2)	4 (30.0)	0
	Somewhat agree	25 (44.6)	5 (28.8)	7 (70.0)	2 (100)
	Somewhat disagree	6 (10.7)	6 (25.0)	0	0
	Strongly disagree	0	0	0	0

I might not report a medication error because I was afraid that I might be subject to disciplinary action or even lose my job.	Strongly agree	1 (1.8)	0	0	0
	Somewhat agree	13 (23.2)	8 (33.3)	3 (30.0)	0
	Somewhat disagree	21 (37.5)	6 (25.0)	2 (20.0)	0
	Strongly disagree	21 (37.5)	10 (41.7)	5 (50.0)	2 (100.0)

It should be noted that data related to nurse perceptions of medication errors and error reporting are only available for one diploma graduate. Because of the lack of results for diploma RN participants, only associate and bachelor's degree data will be discussed. The diploma participant data are provided for the reader to be able to compare it to the responses from those with other degrees.

Associate degree (ADN) (92.0%) and bachelor's degree (BSN) (90.9%) nurses reported similar beliefs that they were sure what constitutes a medication error. Both groups also indicated confidence that they knew when to report a medication error on an incident report (ADN 88.0% and BSN 83.5%). Almost half of the participants from both degree groups "Strongly agreed" that some medication errors are not reported because of a fear of the response of a nurse manager or co-worker (ADN 46.0% and BSN 45.5%), with BSN graduates indicating greater overall agreement (91.0%) than the ADN nurses (84%). Although most nurses from both degree paths reported that fear of disciplinary action or possible loss of their job due to making a medication error would not deter them from reporting their own error, it should be noted that a quarter or more of these nurses were concerned about the results of reporting their error (ADN 28.0% and BSN 25.0%).

Table 8

New Graduate RN Perceptions about Medication Errors and Error Reporting by Degree Type

		RN Degree		
		Associate degree	Bachelor's degree	Diploma
		<i>n</i> (% within group)	<i>n</i> (% within group)	<i>n</i> (% within group)
I am usually sure what constitutes a medication error.	Strongly agree	8 (16.0)	7 (15.9)	0
	Somewhat agree	38 (76.0)	33 (75.0)	1 (100.0)
	Somewhat disagree	2 (4.0)	4 (9.1)	0
	Strongly disagree	2 (4.0)	0	0
I am usually sure when a medication error should be reported using an incident report.	Strongly agree	15 (30.0)	13 (29.5)	0
	Somewhat agree	29 (58.0)	24 (54.5)	1 (100.0)
	Somewhat disagree	6 (12.0)	7 (15.9)	0
	Strongly disagree	0	0	0
Some medication errors are not reported because nurses are afraid of the reaction they will receive from the nurse manager or coworkers.	Strongly agree	23 (46.0)	20 (45.5)	1 (100.0)
	Somewhat agree	19 (38.0)	20 (45.5)	0
	Somewhat disagree	8 (16.0)	4 (9.1)	0
	Strongly disagree	0	0	0
I might not report a medication error because I was afraid that I might be subject to disciplinary action or even lose my job.	Strongly agree	1 (2.0)	0	0
	Somewhat agree	13 (26.0)	11 (25.0)	0
	Somewhat disagree	13 (26.0)	17 (38.6)	1 (100.0)
	Strongly disagree	23 (46.0)	16 (36.4)	0

There were distinct trends in what nurses identified as the most frequent causes of medication errors. The overall ranking of causes can be seen in Table 5. When the list of causes was examined by gender, age, RN degree, and work unit, the most frequent error causes identified for each demographic group were the same as the results from the participants as a whole, with only a few exceptions. Table 9 displays the three causes that were selected by each demographic category as the “most frequent cause of medication errors”. Across gender, age and RN degree groups, distractions and the nurse being tired and exhausted were identified overwhelmingly as the top causes of medication errors. Next most frequent medication error cause across these groups was the nurse failing to check the patient’s name band against the medication administration record (MAR). When evaluating causes identified by work unit there was slightly more variability. Several of the groups contained less than five, so it is questionable whether the findings would be the same with a larger group, but the identified causes differ only slightly from the larger groups. Causes related to handling medications and dosage calculations were identified by participants on units where the nurse is often responsible for more mixing or preparing, such as pediatrics, mental health/psychiatric, and step-down. It is also notable that the most frequent cause of errors in the Specialty Services was setting up an infusion device, although there were only three participants from the three areas in this category, two of the three identified this cause and worked in different types of units.

Table 9

Top Three Selections for the Most Frequent Medication Error Cause by Gender, Age, RN Degree, and Work Unit

	<u><i>n</i></u>	1		2		3	
		Cause	%	Cause	%	Cause	%
<u>Gender</u>							
Male	11	distracted	54.5	tired & exhausted	27.30	set infusion device incorrectly or doctor's writing illegible	9.1
Female	82	distracted	42.7	tired & exhausted	25.6	failed to check name band with MAR	14.6
Other/ No answer	2	distracted	50.0	tired & exhausted	50.0	-----	
<u>Age groups</u>							
20 – 29	56	distracted	48.2	tired & exhausted	28.6	failed to check name band with MAR	10.7
30 – 39	24	distracted	37.5	tired & exhausted	16.7	failed to check name band with MAR	16.7
40 – 49	10	tired & exhausted	50.0	distracted	30.0	set infusion device incorrectly	10.0
50 – 59	2	distracted	50.0	failed to check name band with MAR	50.0	-----	

	<u>n</u>	1		2		3	
		Cause	%	Cause	%	Cause	%
<u>RN degree</u>							
Associate	50	distracted	48.0	tired & exhausted	22.0	failed to check name band with MAR	18.0
Bachelor's	44	distracted	40.9	tired & exhausted	29.6	failed to check name band or set infusion device incorrectly	6.8
Diploma	1	tired & exhausted	100				
<u>Work unit</u>							
Medical-Surgical*	31	distracted	58.1	failed to check name band with MAR	16.1	tired & exhausted	12.9
Cardiology	6	tired & exhausted	66.7	distracted	33.3		
Pediatric	3	distracted	66.7	miscalculated dose	33.3		
OB/GYN	4	tired & exhausted	50.0	distracted	25.0	doctor's writing hard to read/illegible	25.0
Mental Health/Psychiatric	3	distracted	33.3	tired & exhausted	33.3	confused two similar drug names	33.3
Step-down	12	tired & exhausted	33.3	distracted	25.0	miscalculated dose	16.7
Critical care	19	distracted	42.1	tired & exhausted	21.1	failed to check name band with MAR	21.1
Emergency Department	14	distracted	42.9	tired & exhausted	35.7	failed to check name band with MAR	14.3
Specialty Services**	3	set up infusion device incorrectly	66.7	distracted	33.3		

Note: MAR - medication administration record

*Note: Medical-Surgical includes oncology, orthopedic, neurology, inpatient rehabilitation. Cardiology was not included because the data skewed the medical-surgical results.

**Note: Specialty services include operating room, outpatient procedure clinic, and outpatient surgical center.

Specific Aim 2

Examine prelicensure nursing education program experiences that new graduate RNs report were effective in preparing them to safely manage medications and what additional experiences would have made them better prepared.

For the purposes of this study, an experience was considered to be effective if the participant rated it as “Very effective” or “Effective.” To identify a response of effective the responses of the two categories were added together. The number who selected “Not taken/NA” or “Not used/NA” was subtracted from the total number of responses. This adjusted number of participants who had been exposed to the experience was used with the number of effective responses to calculate the percentage of new graduate RNs who perceived the experience was effective.

Research question 7. What do new graduate RNs report were the courses, teaching strategies, activities, or equipment used in their prelicensure nursing programs that effectively prepared them to safely manage medications (prepare, administer, and monitor)?

New graduate RNs reported the clinical portions of the first (84.5%) and other clinical courses (91.3%) as effective preparation for safe medication management. The fundamentals of nursing (78.4%) and fundamentals lab (78.1%) were seen as about equally effective means of preparation, but less effective than clinicals. Also seen as effective preparation courses were the classroom portion of a clinical course other than the first course (77.0%) and a stand-alone skills course (79.4%). Fewer participants rated

other classroom courses, such as the classroom portion of the first clinical course (64.9%) and pharmacology (68.0%), as effective for preparation for safe medication management.

Table 10

Nursing Education Courses Nurses Perceived as Providing Effective Preparation for Safe Medication Management

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Didn't take/NA
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Fundamentals of nursing	25 (21.4)	66 (56.4)	19 (16.2)	3 (2.6)	3 (2.6)	1 (0.9)
Fundamentals lab	31 (26.7)	58 (50.0)	19 (16.4)	4 (3.4)	2 (1.7)	2 (1.7)
Stand-alone skills course	26 (22.2)	59 (50.4)	18 (15.4)	3 (2.6)	1 (0.9)	10 (8.5)
Pharmacology course	29 (25.0)	41 (35.3)	23 (19.8)	8 (6.9)	2 (1.7)	13 (11.2)
Classroom - first clinical course	17 (14.5)	57 (48.7)	34 (29.1)	5 (4.3)	1 (0.9)	3 (2.6)
Clinical - first clinical course	50 (42.7)	48 (41.0)	15 (12.8)	2 (1.7)	1 (0.9)	1 (0.9)
Classroom - other clinical course	17 (14.7)	70 (60.3)	22 (19.0)	3 (2.6)	1 (0.9)	3 (2.6)
Clinical - other clinical course	55 (47.4)	50 (43.1)	9 (7.8)	1 (0.9)	0	1 (0.9)
Other course*	3 (4.5)	4 (6.0)	5 (7.5)	0	0	55 (82.1)

*Note: Other courses listed were nutrition, pharmacy NCLEX review, pathophysiology, and nursing math review.

Similar to the courses identified as effective, the greatest number of participants found a one-on-one precepted experience with a staff nurse (92.1%) and clinical with some one-on-one with a faculty (92.7%) as effective teaching strategies. A lab course

(80.9%) and simulation experiences (76.3%) were also reported as effective teaching strategies by many more respondents than computer/web-based assignments (37.3%).

Table 11

Nursing Education Teaching Strategies Nurses Perceived as Providing Effective Preparation for Safe Medication Management

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Not used/NA
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Lecture	17 (14.7)	66 (56.9)	24 (20.7)	5 (4.3)	3 (2.6)	1 (0.9)
Lab course (one teacher with a group of students)	37 (31.9)	56 (48.3)	17 (14.7)	3 (2.6)	2 (1.7)	1 (0.9)
Tutorial (lab setting with one teacher and one or two students)	32 (27.8)	49 (42.6)	12 (10.4)	1 (0.9)	1 (0.9)	20 (17.4)
Clinical group with some one-on-one with faculty	56 (48.3)	46 (39.7)	7 (6.0)	0	1 (0.9)	6 (5.2)
Staff nurse preceptor one-on-one with a student	70 (60.3)	35 (30.2)	8 (6.9)	0	1 (0.9)	2 (1.7)
Problem-based learning	21 (18.1)	54 (46.6)	27 (23.3)	2 (1.7)	2 (1.7)	10 (8.6)
Simulated clinical experience (any type of simulation)	32 (27.6)	55 (47.4)	17 (14.7)	7 (6.0)	3 (2.6)	2 (1.7)
Computer/web-based assignment	12 (10.4)	26 (22.6)	33 (28.7)	25 (21.7)	6 (5.2)	13 (11.3)
Other teaching strategy*	3 (3.7)	2 (2.5)	3 (3.7)	1 (1.2)	0	72 (88.9)

*Note: Other teaching strategies listed were "book readings" and "case studies."

The activities and equipment that the participants most frequently identified as effective in preparing them for safe medication management were bar-code scanners (91.1%), smart infusion devices (IV pump with drug database; 89.0%), and basic equipment (medicine cups, syringes, medicine cart; 87.2%). Other activities and equipment identified by greater than 50% of the participants as effective were electronic medication dispensing carts/machines (83.7%), partial task trainers (injection pads, IV arm; 73.8%), electronic health record (EHR) (70.7%), computer-based programs (dosage calculation, clinical scenarios; 62.9%), full-body high-fidelity manikin (life-like computerized manikin; 61.7%), and full-body medium-fidelity manikin (some electronics; 61.8%). Even though a large number of participants indicated they had not used some of the activities or equipment, a few of the experiences were still identified as effective by more than half of respondents: standardized patients (72.9%), computer-based task trainer (58.6%).

Table 12

Nursing Education Activities and Equipment Nurses Perceived as Providing Effective Preparation for Safe Medication Management

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Not used/NA
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Basic equipment (medicine cups, syringes, medicine cart)	45 (40.9)	50 (45.5)	12 (10.9)	2 (1.8)	0	1 (0.9)
Partial task trainers (injection pad, IV arm)	26 (23.6)	53 (48.2)	19 (17.3)	7 (6.4)	2 (1.8)	3 (2.7)

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Not used/NA
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Computer-based programs (dosage calculation, clinical scenarios)	21 (19.1)	40 (36.4)	24 (21.8)	9 (8.2)	3 (2.7)	13 (11.8)
Computer-based task trainer (IV trainer with haptic device)	13 (11.8)	28 (25.5)	18 (16.4)	8 (7.3)	3 (2.7)	40 (36.4)
Virtual reality systems (computer system w/headset and/or gloves)	10 (9.2)	11 (10.1)	17 (15.6)	6 (5.5)	4 (3.7)	61 (56.0)
Full-body simple manikin	15 (13.8)	39 (35.8)	29 (26.6)	13 (11.9)	3 (2.8)	10 (9.2)
Full-body medium-fidelity manikin (some basic electronics)	15 (13.6)	40 (36.4)	24 (21.8)	9 (8.2)	2 (1.8)	20 (18.2)
Full-body high-fidelity manikin (life-like computerized manikin)	22 (20.0)	28 (34.5)	14 (12.7)	6 (5.5)	1 (0.9)	29 (26.4)
Standardized patients (trained, live patient actors)	19 (17.3)	24 (21.8)	14 (12.7)	2 (1.8)	0	51 (46.4)
Peer patients (other students in class)	18 (16.4)	34 (30.9)	25 (22.7)	10 (9.1)	1 (0.9)	22 (20.0)
Electronic health record (EHR)	29 (26.4)	41 (37.3)	28 (25.5)	1 (0.9)	0	11 (10.0)
Electronic medication dispensing cart/machine	33 (30.0)	49 (44.5)	14 (12.7)	1 (0.9)	1 (0.9)	12 (10.9)
Bar-code scanner	49 (44.5)	43 (39.1)	8 (7.3)	1 (0.9)	0	9 (8.2)
Smart infusion devices (IV pump with drug database)	45 (41.3)	44 (40.4)	8 (7.3)	2 (1.8)	1 (0.9)	9 (8.3)
Other activity or equipment*	4 (5.0)	3 (3.8)	3 (3.8)	0	0	70 (87.5)

*Note: Other activity or equipment listed were "nurse co-sign requirement on MAR" and "drug books."

Research question 8. What do new graduate RNs think could have been done differently in their nursing education program to better prepare them to safely manage medications?

The participants were asked in an open-ended question what they thought could have been done differently in their nursing education program to better prepare them to safely manage medications. There were 59 responses that addressed the topic. The responses were copied verbatim and reviewed by the researcher for common themes or phrases. After a second review, 62 pertinent phrases were identified that fell into five main themes: more practice opportunities, safety, pharmacology course, enhanced instruction, and time/stress management. Comments about additional practice opportunities constituted almost half of all the key statements (28), and related to the desire for more practice activities in clinical, additional lab time, more simulations, and an opportunity to use authentic equipment (medication dispensing machines, bar-code scanners, IV pumps). Comments included statements such as “more clinical or lab time for medication preparation and administration”, “more time spent in lab, more equipment available for hands on learning”, “more opportunities available to actually distribute medication to the patients during clinical time”, “more Sim labs”, and “more hands-on experience during clinical rotations.”

The theme that received the second most frequent number of comments (13) was related to safety. The respondents stated that there should be a clear definition of a medication error; there should be more emphasis on common mistakes, error causes, and error prevention; and there should be a change of “the focus from drug cards and

extensive knowledge about the drugs...to safe administration.” Some of the statements the participants used to describe their desired change were “put more emphasis on the effects, administration perimeters [sic], and other critical thinking administration information”; “more examples of how mistakes were made”; and “more emphasis on the reality of medication errors and what can be done to prevent them.”

There were 10 comments about the need for a required, robust pharmacology course. Comments included statements about “better pharmacology class”, “a more thorough pharmacology class”, and “mandatory pharmacology course.”

Enhanced instruction statements (6) were focused on the need for more interactive instruction, more real-world, complex situations, and more precepted clinicals.

Participants reported a need for “more interactive teaching, not lecture style, but actively participating in learning”, “having more complex questions...real life issues such as patients off floor, late administration of medications due to patient load and care”, and “more patient scenarios.”

Time and stress management (5) comments primarily indicated a desire for educational experiences. The participants identified the benefit of “more practice passing multiple medications at one time”, “taking on more patients during clinical to learn time management skills”, and “stress management/coping strategies because most errors are due to being overwhelmed.”

Research question 9. What do new graduate RNs report were the review topics, teaching strategies, activities, or equipment used in their workplace orientation that

effectively prepared them to safely manage medications (prepare, administer, and monitor)?

The greatest number of participants found that review of the use of the medication administration record (MAR or eMAR) (90.6%), the use of the EHR (87.6%), and equipment operation (86.5%) were effective in preparing them to safely manage medications. A review of policies and procedures was also found effective by 71.4% of the participants.

Table 13

Orientation Review Topics Nurses Perceived as Providing Effective Preparation for Safe Medication Management

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Not reviewed/ NA
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Policies and procedures	20 (18.7)	55 (51.4)	24 (22.4)	6 (5.6)	0	2 (1.9)
Medication error causes	23 (21.5)	38 (35.5)	30 (28.0)	8 (7.5)	0	8 (7.5)
Medication error reporting	19 (17.8)	45 (42.1)	27 (25.2)	8 (7.5)	0	8 (7.5)
Dosage calculation	23 (21.5)	37 (34.6)	21 (19.6)	9 (8.4)	0	17 (15.9)
Equipment operation	36 (33.6)	54 (50.5)	10 (9.3)	4 (3.7)	0	3 (2.8)
Use of electronic health record (EHR)	49 (45.8)	43 (40.2)	12 (11.2)	1 (0.9)	0	2 (1.9)
Use of medication administration record (MAR or eMAR)	55 (51.4)	41 (38.3)	9 (8.4)	1 (0.9)	0	1 (0.9)
Other review topic	7 (8.9)	3 (3.8)	3 (3.8)	0	0	66 (83.5)

Note: Other review topics listed were "where to find hospital policies", pharmacist or clinical educator available", "peer support", "paper charting", "high alert medications/look alike, sound alike", biohazard med training", and "actual examples of errors in past."

By far the teaching strategy most frequently identified as effective for preparing the respondents for safe medication management was working one-on-one with a preceptor (100%). Many of the participants reported that the various strategies were not used in their orientation, but did not identify other strategies that were. The second and third most frequently used workplace orientation teaching strategies were identified as

effective by the fewest number of RNs: lecture (47.7%) and computer/web-based assignment (52.1%).

Table 14

Orientation Teaching Strategies Nurses Perceived as Providing Effective Preparation for Safe Medication Management

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Not used/NA
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Lecture	11 (10.5)	30 (28.6)	30 (28.6)	13 (12.4)	2 (1.9)	19 (18.1)
Tutorial (lab setting with one teacher and one or two students)	20 (19.2)	34 (32.7)	9 (8.7)	2 (1.9)	1 (1.0)	38 (36.5)
Nurse preceptor one-on-one with new nurse	70 (66.7)	34 (32.4)	0	0	0	1 (1.0)
Simulated clinical experience (any type of simulation)	20 (19.0)	32 (30.5)	7 (6.7)	3 (2.9)	1 (1.0)	42 (40.0)
Computer/web-based assignment	14 (13.3)	23 (21.9)	23 (21.9)	10 (9.5)	1 (1.0)	34 (32.4)
Other teaching strategy	2 (2.7)	1 (1.3)	2 (2.7)	1 (1.3)	0	69 (92.0)

Note: No Other teaching strategies were identified.

The activities and equipment identified by the greatest number of participants as effective closely mirrored the review topics that were also found to be effective. A large majority of the nurses found use of a bar-code scanner (94.6%), electronic medication dispensing carts/machines (95.6%), smart infusion devices (91.9), basic equipment (medicine cup, syringes, medicine cart) (88.3%), and the EHR (86.7%) during their

orientation to be effective in preparing them to safely manage medications. Most of the rest of the activities and equipment were identified as not used during the orientation of a majority of the participants and had lower identification as effective.

Table 15

Orientation Activities and Equipment Nurses Perceived as Providing Effective Preparation for Safe Medication Management

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Not used/NA
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Basic equipment (medicine cups, syringes, medicine cart)	45 (46.9)	38 (39.6)	9 (9.4)	2 (2.1)	0	2 (2.1)
Partial task trainers (injection pad, IV arm)	11 (11.5)	18 (18.8)	8 (8.3)	3 (3.1)	1 (1.0)	55 (57.3)
Computer-based programs (dosage calculation, clinical scenarios)	13 (13.7)	23 (24.2)	11 (11.6)	2 (2.1)	0	46 (48.4)
Computer-based task trainer (IV trainer with haptic device)	13 (13.4)	8 (8.2)	9 (9.3)	2 (2.1)	1 (1.0)	64 (66.0)
Virtual reality systems (computer system w/headset and/or gloves)	6 (6.2)	10 (10.3)	5 (5.2)	3 (3.1)	0	73 (75.3)
Full-body simple manikin	12 (12.4)	14 (14.4)	5 (5.2)	1 (1.0)	1 (1.0)	64 (66.0)

	Very Effective	Effective	Neutral	Ineffective	Very Ineffective	Not used/NA
	<i>v</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Full-body medium-fidelity manikin (some basic electronics)	10 (10.4)	15 (15.6)	7 (7.3)	2 (2.1)	0	62 (64.6)
Full-body high-fidelity manikin (life-like computerized manikin)	11 (11.3)	16 (16.5)	3 (3.1)	1 (1.0)	0	66 (68.0)
Standardized patients (trained, live patient actors)	10 (10.3)	16 (16.5)	2 (2.1)	0	1 (1.0)	68 (70.1)
Peer patients (other new nurses)	12 (40.2)	21 (21.6)	10 (10.3)	1 (1.0)	0	53 (54.6)
Electronic health record (EHR)	39 (40.2)	39 (40.2)	10 (10.3)	2 (2.1)	0	7 (7.2)
Electronic medication dispensing cart/machine	39 (40.2)	47 (48.5)	3 (3.1)	1 (1.0)	0	7 (7.2)
Bar-code scanner	52 (53.6)	35 (36.1)	3 (3.1)	2 (2.1)	0	5 (3.8)
Smart infusion devices (IV pump with drug database)	47 (49.0)	32 (33.3)	6 (6.3)	1 (1.0)	0	10 (10.4)
Other activity or equipment*	3 (4.1)	5 (6.8)	1 (1.4)	0	0	64 (87.7)

*Note: Other activity or equipment listed were "tests", "nurse co-sign requirement", and "live feedback."

Research question 10. What do new graduate RNs think could have been done differently in their workplace orientation to better prepare them to safely manage medications?

The participants were asked in an open-ended question about what they thought could have been done differently in their workplace orientation to better prepare them to safely manage medications. There were 36 responses that addressed the topic. The responses were copied verbatim and reviewed by the researcher for common themes or phrases. After a second review, 38 pertinent phrases were identified that were coded into four main themes: medication management, policies and procedures, orientation structure, and orientation length.

Statements related to medication management identified the need for “more time working with the equipment”, a focus on unit specific skills, and simulation. One participant stated “I do, however, wish the training was more in depth in terms of hands-on experience. They could have used simulated scenarios more.” Others commented on a need to “emphasize the administration parameters and critical thinking for medication administration for my specific floor” and “more emphasis on practicing calculating and remembering safe ranges (pediatrics).”

Policies and procedures (9) comments identified the need for a thorough review of hospital policies, a clear definition of a medication error, and information about error reporting, including completing incident reports. The participants recommend that orientation programs “place more emphasis on policy and procedures”, “have a specific review of hospital policy regarding what constitutes a medication error”, teach new nurses “more about reporting medication errors”, and “go over incident reporting in depth.”

There were multiple comments about the orientation program structure (9) that mainly focused on the need to “start education classes earlier” so error information was

presented before starting work on the unit; to have a residency program available, and when a residency is available to have it focused on the participant's practice area; instruction that is "more hands on versus computer and lecture"; and "less redundancy." One participant also commented that there was "no clear guide how to precept and what needs to be taught."

Orientation length (8) was addressed by several participants by simply stating "longer orientation" or "more time." Some others expanded slightly by saying "longer orientation with preceptor" or "longer orientation more extensive to the units [sic] equipment as far as the supply room, pyxis room, and pump usage."

Research question 11. Do nurse-reported effective preparation experiences differ based on demographic characteristics?

Contingency tables with within group percentages were calculated to identify relationships between demographic characteristics (gender, age group, RN degree, and work unit) and nursing education courses, teaching strategies, activities and equipment that participants had identified as effective in preparing them for safe medication administration.

Of those who took the courses, males found lab and clinical settings more effective than females, although many in both groups found all the courses effective. The least effective course for males and females was the pharmacology course. The percentage of nurses who identified courses as effective increased the older they were. With the exception of the pharmacology course and the classroom portion of clinical

courses, a greater percentage of the BSN nurses found the courses effective than the ADN nurses.

Table 16

Courses Identified as Effective Preparation for Safe Medication Management by Gender, Age Group, and RN Degree

	Gender		Age group				RN Degree		
	Male	Female	20-29	30-39	40-49	50-59	ADN	BSN	Dip
	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)
Fundamentals of nursing	8 (72.7)	66 (81.5)	43 (78.2)	21 (87.5)	8 (80.0)	2 (100)	38 (76.0)	37 (86.0)	0
Fundamentals lab	9 (90.0)	60 (74.1)	39 (70.9)	19 (82.6)	9 (90.0)	2 (100)	33 (67.3)	37 (86.0)	1 (100)
Stand-alone skills course	10 (90.9)	58 (77.3)	43 (78.2)	16 (84.2)	8 (88.9)	2 (100)	36 (76.6)	33 (82.5)	1 (100)
Pharmacology course	7 (70.0)	47 (65.3)	32 (65.3)	61 (71.4)	7 (77.8)	1 (50.0)	33 (75.0)	22 (56.4)	1 (100)
Classroom - first clinical course	9 (81.8)	50 (63.3)	35 (64.8)	17 (70.9)	6 (66.7)	2 (100)	33 (68.8)	27 (62.8)	0
Clinical - first clinical course	10 (90.9)	69 (85.2)	47 (83.9)	21 (87.5)	9 (100)	2 (100)	41 (83.7)	39 (88.6)	1 (100)
Classroom - other clinical course	10 (100)	61 (77.2)	42 (79.2)	20 (83.4)	7 (77.8)	2 (100)	38 (80.9)	34 (79.1)	0
Clinical - other clinical course	10 (100)	73 (90.1)	50 (90.9)	22 (91.7)	9 (100)	2 (100)	43 (89.6)	41 (93.2)	1 (100)

Note: ADN – Associate Degree in Nursing, BSN – Bachelor of Science in Nursing, Dip – Diploma

Table 17

Teaching Strategies Identified as Effective Preparation for Safe Medication Management by Gender, Age Group, and RN Degree

	Gender		Age group				RN Degree		
	Male	Female	20-29	30-39	40-49	50-59	ADN	BSN	Dip
	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)
Lecture	7 (63.6)	60 (74.1)	41 (74.5)	18 (75.0)	7 (70.0)	1 (50.0)	36 (72.0)	31 (72.1)	1 (100)
Lab course (one teacher with a group of students	10 (90.9)	64 (78.0)	33 (58.9)	20 (87.0)	9 (90.0)	2 (100)	39 (79.6)	36 (81.8)	1 (100)
Tutorial (lab setting with one teacher and one or two students)	7 (87.5)	56 (84.8)	35 (79.5)	18 (90.0)	7 (100)	2 (100)	33 (86.8)	30 (83.3)	1 (100)
Clinical group with some one-on-one with faculty	7 (87.5)	74 (93.7)	48 (90.6)	22 (100)	9 (100)	2 (100)	42 (91.3)	40 (95.2)	1 (100)
Staff nurse preceptor one- on-one with a student	10 (90.9)	74 (91.4)	51 (92.7)	22 (91.7)	8 (80.0)	2 (100)	45 (91.8)	40 (90.9)	1 (100)
Problem- based learning	7 (70.0)	52 (69.3)	35 (68.6)	17 (77.3)	4 (50.0)	2 (100)	37 (78.7)	22 (57.9)	1 (100)
Simulated clinical experience (any type of simulation)	9 (81.8)	59 (73.8)	40 (72.7)	21 (87.5)	6 (66.7)	2 (100)	42 (85.7)	28 (65.1)	0
Computer/web -based assignment	3 (33.3)	30 (40.5)	17 (34.0)	11 (52.4)	4 (50.0)	2 (100)	22 (47.8)	12 (32.4)	0

Note: ADN – Associate Degree in Nursing, BSN – Bachelor of Science in Nursing, Dip – Diploma

Table 18

Activities and Equipment Identified as Effective Preparation for Safe Medication Management by Gender, Age Group, and RN Degree

	Gender		Age group				RN Degree		
	Male	Female	20-29	30-39	40-49	50-59	ADN	BSN	Dip
	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)
Basic equipment (medicine cups, syringes, medicine cart)	10 (90.9)	71 (87.7)	48 (85.7)	22 (95.7)	9 (90.0)	2 (100)	47 (94.0)	35 (81.4)	1 (100)
Partial task trainers (injection pad, IV arm)	9 (81.8)	57 (71.3)	40 (71.4)	18 (78.3)	6 (60.0)	2 (100)	35 (72.9)	31 (70.5)	1 (100)
Computer-based programs (dosage calculation, clinical scenarios)	4 (36.4)	45 (60.8)	29 (55.8)	13 (68.4)	5 (55.6)	2 (100)	34 (73.9)	16 (42.1)	0
Computer-based task trainer (IV trainer with haptic device)	6 (75.0)	30 (56.6)	21 (56.8)	12 (85.7)	1 (16.7)	1 (50.0)	23 (76.7)	13 (43.3)	1 (100)

	Gender		Age group				RN Degree		
	Male	Female	20-29	30-39	40-49	50-59	ADN	BSN	Dip
	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)
Virtual reality systems (computer system w/headset and/or gloves)	3 (100)	16 (41.0)	12 (48.0)	7 (63.6)	1 (25.0)	0	15 (62.5)	5 (26.3)	0
Full-body simple manikin	6 (66.7)	40 (53.3)	29 (54.7)	13 (61.9)	3 (42.9)	2 (100)	28 (59.6)	20 (52.6)	0
Full-body medium-fidelity manikin (some basic electronics)	6 (85.7)	40 (57.1)	26 (57.8)	14 (63.6)	4 (66.7)	2 (100)	28 (66.7)	18 (51.4)	1 (100)
Full-body high-fidelity manikin (life-like computerized manikin)	8 (88.9)	44 (72.1)	30 (69.8)	18 (90.0)	4 (66.7)	1 (100)	31 (83.8)	22 (64.7)	1 (100)
Standardized patients (trained, live patient actors)	4 (80.0)	33 (71.7)	26 (76.5)	9 (81.8)	2 (50.0)	0	22 (78.6)	15 (65.2)	0
Peer patients (other students in class)	4 (50.0)	43 (64.2)	29 (64.4)	13 (61.9)	3 (42.9)	2 (100)	24 (58.5)	24 (68.6)	1 (100)
Electronic health record (EHR)	8 (72.7)	49 (67.1)	37 (69.8)	15 (68.2)	4 (50.0)	0	33 (70.2)	25 (65.8)	0

	Gender		Age group				RN Degree		
	Male	Female	20-29	30-39	40-49	50-59	ADN	BSN	Dip
	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)	<i>n</i> (%) within group)
Electronic medication dispensing cart/ machine	10 (100)	60 (81.1)	41 (82.0)	21 (87.5)	7 (87.5)	1 (100)	40 (85.1)	31 (81.6)	1 (100)
+Bar-code scanner	10 (100)	67 (89.3)	45 (90.0)	22 (91.7)	8 (88.9)	1 (100)	45 (93.8)	33 (86.8)	1 (100)
Smart infusion devices (IV pump with drug database)	9 (100)	66 (86.8)	43 (80.4)	22 (95.7)	9 (100)	1 (100)	42 (91.3)	34 (85.0)	1 (100)

Note: ADN – Associate Degree in Nursing, BSN – Bachelor of Science in Nursing, Dip – Diploma

Specific Aim 3

Describe how new graduate RNs are being prepared to safely administer medications in prelicensure programs in NC.

Research question 12. Where in the nursing curriculum is medication management most frequently taught?

Multiple response sets were used to identify which courses, teaching strategies, activities, and equipment were used during nursing education and the percentage of programs that used them. The majority of nursing education programs introduced safe medication management information for the first time in a fundamentals of nursing course (97.1%) and the fundamentals lab (94.3%). New medication management

information was also taught by between 40% and 50% of the participant programs in other courses across the curriculum.

Table 19

Nursing Education Courses Where Initial Safe Medication Management Information Is Taught

	<i>n</i>	%	% of cases
Fundamentals of nursing	34	23.9	97.1
Fundamentals lab	33	23.2	94.3
Clinical - first clinical course	17	12.0	48.6
Pharmacology course	15	10.6	42.9
Clinical - other clinical course	15	10.6	42.9
Classroom - first clinical course	14	9.9	40.0
Classroom - other clinical course	11	7.7	31.4
Stand-alone skills course	3	2.1	8.6

Research question 13. What teaching strategies are most commonly used to teach safe medication management?

The most frequent teaching strategies used to teach new medication management information were a lab course (97.1%) and lecture (94.3%). The other strategies used by a majority of programs was in a clinical group (80.0%) or a simulated clinical experience (80.0%).

Table 20

Strategies Used to Teach Initial Safe Medication Management Information

	<i>n</i>	%	% of cases
Lab course (one teacher with a group of students)	34	19.4	97.1
Lecture	33	18.9	94.3
Clinical group with some one-on-one with faculty	28	16.0	80.0
Simulated clinical experience (any type of simulation)	28	16.0	80.0
Computer/web-based assignment	17	9.7	48.6
Tutorial (lab setting with one teacher and one or two students)	15	8.6	42.9
Staff nurse preceptor one-on-one with a student	10	5.7	28.6
Problem-based learning	10	5.7	28.6

Research question 14. What activities and equipment are most frequently used to teach safe medication management?

All of the participant programs indicated that they used basic equipment and partial task trainers to teach safe medication management. Less frequent activities or equipment used were computer-based programs (71.4%), an EHR (60.0%), and full-body simple manikins (57.1%). Common health care technology such as smart infusion devices (54.3%), electronic medication dispensing carts/machines (54.3%), or bar-code scanners (40.0%) were used by approximately half of the programs or less.

Table 21

Activities and Equipment Used to Teach Initial Safe Medication Management Information

	<i>n</i>	%	% of cases
Basic equipment (medicine cups, syringes, medicine cart)	35	14.0	100.0
Partial task trainers (injection pad, IV arm)	35	14.0	100.0
Computer-based programs (dosage calculation, clinical scenarios)	25	10.0	71.4
Electronic health record (EHR)	21	8.4	60.0
Full-body simple manikin	20	8.0	57.1
Smart infusion devices (IV pump with drug database)	19	7.6	54.3
Electronic medication dispensing cart/machine	19	7.6	54.3
Full-body medium-fidelity manikin (some basic electronics)	19	7.6	54.3
Full-body high-fidelity manikin (life-like computerized manikin)	15	6.0	42.9
Bar-code scanner	14	5.6	40.0
Peer patients (other students in class)	13	5.2	37.1
Computer-based task trainer (IV trainer with haptic device)	10	4.0	28.6
Standardized patients (trained, live patient actors)	3	1.2	8.6
Virtual reality systems (computer system w/headset and/or gloves)	1	0.4	2.9
Other activity and/or equipment*	1	0.4	2.9

*Note: Other activity and/or equipment listed was "posters with instructions for med calcs and dispensing from multi-dose container".

Research question 15. How do the courses, teaching strategies, activities, and equipment used to teach medication management in nursing programs compare to the effective preparation experiences reported by new graduate RNs?

There is a notable discrepancy between the courses nursing programs were using to teach new medication management information and what the new RNs identified most frequently as effective. More than 90% of the new graduates identified clinical courses other than their first course as effective in preparing them for safe medication management, but less than half (48.6%) of the nursing programs identified this as a course with a focus on medication management information. The two courses where nursing programs most frequently reported new medication management information was taught, fundamentals (97.1%) and fundamentals lab (94.3%), were only found to be effective by about three fourths of the new graduates (78.4% and 78.1% respectively). The two clinical courses also reflect high level of effectiveness (other clinical course - 91.3% and first clinical course -84.5%), based on new graduate perceptions, but were identified by less than half of the programs as a course where medication management was taught (other clinical course - 42.8% and first clinical course - 48.6%).

Table 22

Comparison of Nursing Education Courses Where New Medication Management Information is Taught and Perceived Effectiveness by New Graduate RNs

	# Programs Using	% Programs Using	# Identified Course Effective	% Identified Course Effective
Fundamentals of nursing	34	97.1	91	78.4
Fundamentals lab	33	94.3	89	78.1
Clinical - first clinical course	17	48.6	98	84.5
Pharmacology course	15	42.9	70	68.0
Clinical - other clinical course	15	42.9	105	91.3
Classroom - first clinical course	14	40.0	74	64.9
Classroom - other clinical course	11	31.4	87	77.0
Stand-alone skills course	3	8.6	85	79.4

Clinical group (92.7%), one-on-one preceptor (92.1%), and tutorial (85.3%) are identified by new graduates most frequently as effective strategies to learn safe medication management. Of these three, only the clinical group falls in the top three strategies used by nursing programs. The strategy used to teach medication management by the largest percentage of nursing programs is a lab course (97.1%), which is seen as effective by 80.9% of new graduate nurses. The second most frequent strategy used by nursing programs is lecture (94.3%), and it is identified by only 72.2% of the new graduate nurses as effective.

Table 23

Comparison of Nursing Education Teaching Strategies to Teach New Medication Management Information and Perceived Effectiveness by New Graduate RNs

	# Programs Using	% Programs Using	# Identified Strategy Effective	% Identified Strategy Effective
Lab course (one teacher with a group of students)	34	97.1	93	80.9
Lecture	33	94.3	83	72.2
Clinical group with some one-on-one with faculty	28	80.0	102	92.7
Simulated clinical experience (any type of simulation)	28	80.0	87	76.3
Computer/web-based assignment	17	48.6	38	37.3
Tutorial (lab setting with one teacher and one or two students)	15	42.9	81	85.3
Staff nurse preceptor one-on-one with a student	10	28.6	105	92.1
Problem-based learning	10	28.6	75	70.8

Additional differences between how medication management is taught and what nurses identify as effective can be found in the activities and equipment used. The item identified by the greatest number of nurses as effective is the bar-code scanner (91.1%), but it was identified by only 40.0% of the education programs as being used to teach medication management. Another item with a high report of effectiveness is the smart infusion device (89.0%), but barely half of the education programs (54.3%) identify that they use it for medication management instruction. The use of basic equipment appears

to be fairly universal (100%), and it is also seen as effective by the new graduate nurses (87.2%). The nursing programs appear to rely on a small number of activities or equipment to teach medication management, but the nurses indicate from their responses that a wider range of resources would be effective.

Table 24

Comparison of Nursing Education Activities and Equipment Used to Teach New Medication Management Information and Perceived Effectiveness by New Graduate RNs

	# Programs Using	% Programs Using	# Identified Activity/ Equipment Effective	% Identified Activity/ Equipment Effective
Basic equipment (medicine cups, syringes, medicine cart)	35	100.0	95	87.2
Partial task trainers (injection pad, IV arm)	35	100.0	79	73.8
Computer-based programs (dosage calculation, clinical scenarios)	25	71.4	61	62.9
Electronic health record (EHR)	21	60.0	70	70.7
Full-body simple manikin	20	57.1	54	54.0
Smart infusion devices (IV pump with drug database)	19	54.3	89	89.0
Electronic medication dispensing cart/machine	19	54.3	82	83.7
Full-body medium-fidelity manikin (some basic electronics)	19	54.3	55	61.8
Full-body high-fidelity manikin (life-like computerized manikin)	15	42.9	50	61.7
Bar-code scanner	14	40.0	92	91.1
Peer patients (other students in class)	13	37.1	52	59.1
Computer-based task trainer (IV trainer with haptic device)	10	28.6	41	58.6
Standardized patients (trained, live patient actors)	3	8.6	43	72.9
Virtual reality systems (computer system w/headset and/or gloves)	1	2.9	21	43.8

Specific Aim 4

Describe how new graduate RN workplace orientation ensures competency to safely manage medications.

Research question 16. What review topics, teaching strategies, activities, or equipment are used during new graduate RN workplace orientation to review safe medication management?

Multiple response sets were created to identify which topics, teaching strategies, activities and equipment were used during orientation and the percentage of organizations that used them. There seems to be consistent use of the review topics listed by the majority of the organization participants. Only one other topic was identified when given the opportunity.

Table 25

Safe Medication Management Review Topics Used During New Graduate RN Workplace Orientation

	<i>n</i>	%	% of cases
Policies and procedures	20	15.2	100.0
Medication error reporting	20	15.2	100.0
Electronic health record (EHR)	20	15.2	100.0
Medication administration (MAR or eMAR)	20	15.2	100.0
Equipment operation	18	13.6	90.0
Medication error causes	17	12.9	85.0
Dosage calculation	16	12.1	80.0
Other topic	1	0.8	5.0

Note: Other topic listed was a pharmacology review.

The organizations report mainly using traditional teaching strategies of lecture (85.0%) and preceptors (85.0%), rather than more hands-on experiences such as simulation (35.0%) or lab setting (30.0%).

Table 26

Teaching Strategies Used to Review Safe Medication Management During New Graduate RN Workplace Orientation

	<i>n</i>	<i>%</i>	<i>% of cases</i>
Lecture	17	26.6	85.0
Nurse preceptor one-on-one with a new graduate	17	26.6	85.0
Computer/web-based assignment	16	25.0	80.0
Simulated clinical experience (any type of simulation)	7	10.9	35.0
Tutorial (lab setting with one teacher and one or two new nurses)	6	9.4	30.0

The predominant activities and equipment reported as being used in orientation appear to focus on single equipment items and technology use. Experiences that would require application of the nursing process or integration of multiple skills to manage medications, such a simple (15.0%) or high-fidelity manikin (15.0%) or a standardized patient (10.0%), are rarely used.

Table 27

Activities and Equipment Used to Review Safe Medication Management During New Graduate RN Workplace Orientation

	<i>n</i>	%	% of cases
Bar-code scanner	19	17.0	95.0
Electronic health record (EHR)	17	15.2	85.0
Smart infusion devices (IV pump with drug database)	17	15.2	85.0
Basic equipment (medicine cups, syringes, medicine cart)	14	12.5	70.0
Electronic medication dispensing cart/machine	13	11.6	65.0
Computer-based programs (dosage calculation, clinical scenarios)	11	9.8	55.0
Partial task trainers (injection pad, IV arm)	8	7.1	40.0
Full-body simple manikin	3	2.7	15.0
Full-body high-fidelity manikin (life-like computerized manikin)	3	2.7	15.0
Standardized patients (trained, live patient actors)	2	1.8	10.0
Peer patients (other students in class)	2	1.8	10.0
Full-body medium-fidelity manikin (some basic electronics)	1	0.9	5.0
Computer-based task trainer (IV trainer with haptic device)	1	0.9	5.0
Virtual reality systems (computer system w/headset and/or gloves)	0	0.0	0.0

Research question 17. How are new graduate RNs evaluated to determine medication management competency during workplace orientation?

A multiple response set was created to identify the medication management competency assessment techniques used and the percentage of organizations that reported using each one. Organizations report primarily relying on preceptor evaluation (95.0%) to determine competency. This is followed by a paper and pencil test (30.0%) or a computer-based version of a similar test (65.0%). Authentic, scenario-based testing, such as a simulated experience (25.0%) or computer scenario-based test (15.0%), appear to be fairly rare.

Table 28

Medication Management Competency Assessment Techniques Used During Orientation

	<i>n</i>	%	% of cases
RN preceptor evaluation	19	39.6	95.0
Computer-based test (similar to paper and pencil test)	13	27.1	65.0
Paper and pencil test	6	12.5	30.0
Simulated clinical experience evaluation	5	10.4	25.0
Computer scenario-based test	3	6.3	15.0
Competency is presumed based on passing NCLEX	2	4.2	10.0

Research question 18. How do the content reviews, teaching strategies, activities, and equipment used to review safe medication management during workplace orientation programs compare to the effective orientation experiences reported by new graduate RNs?

The review focus on equipment and technology during orientation, fairly closely matches what the new graduate RNs identify as effective topics to prepare them for safe medication management.

Table 29

Comparison of Workplace Orientation Medication Management Review Topics and Perceived Effectiveness by New Graduate RNs

	# Organizations Using	% Organizations Using	# Identified Review Topic Effective	% Identified Review Topic Effective
Medication administration (MAR or eMAR)	20	100.0	96	90.6
Electronic health record (EHR)	20	100.0	92	87.6
Policies and procedures	20	100.0	75	71.4
Medication error reporting	20	100.0	64	64.6
Equipment operation	18	90.0	90	86.5
Medication error causes	17	85.0	61	61.6
Dosage calculation	16	80.0	60	66.7

All new graduate RNs identified the use of a preceptor as an effective teaching strategy for safe medication management, however, surprisingly, only 85.0% of the organizations surveyed reported using one-on-one preceptors. The other teaching strategy reported most often by organizations was lecture (85.0%). Lecture was seen as effective by less than half of the RN participants (47.7%). Computer-based/web assignments were also rated fairly low in effectiveness by the new graduate RNs (52.1%), but are used by most of the organizations (80.0%). Other hands-on strategies such as

simulation (82.5%) and tutorials (81.8%) were rated highly by the new graduates, but only used by a small portion of the participant organizations (35.0% and 30.0% respectively).

Table 30

Comparison of Workplace Orientation Medication Management Teaching Strategies and Perceived Effectiveness by New Graduate RNs

	# Organizations Using	% Organization s Using	# Identified Strategy Effective	% Identified Strategy Effective
Nurse preceptor one-on-one with a new graduate	17	85.0	104	100.0
Lecture	17	85.0	41	47.7
Computer/web-based assignment	16	80.0	37	52.1
Simulated clinical experience (any type of simulation)	7	35.0	52	82.5
Tutorial (lab setting with one teacher and one or two new nurses)	6	30.0	54	81.8

Organizations reported utilizing frequently used equipment and technology, such as bar-code scanner (95.0%), smart infusion devices (85.0%), EHR (85.0%), during orientation. While a large percentage of new graduates found these effective, they also identified as effective other activities and equipment that could be used for more authentic integration of skills and critical thinking (standardized patients (89.7%), high-fidelity manikin (87.1%), and simple manikins (78.8%)) that the organizations reported using infrequently.

Table 31

Comparison of Activities and Equipment Related to Medication Management Used During Workplace Orientation and Perceived Effectiveness by New Graduate RNs

	# Organizations Using	% Organizations Using	# Identified Activity/ Equipment Effective	% Identified Activity/ Equipment Effective
Bar-code scanner	19	95.0	87	94.6
Smart infusion devices (IV pump with drug database)	17	85.0	79	91.9
Electronic health record (EHR)	17	85.0	78	86.7
Basic equipment (medicine cups, syringes, medicine cart)	14	70.0	83	88.3
Electronic medication dispensing cart/machine	13	65.0	86	95.6
Computer-based programs (dosage calculation, clinical scenarios)	11	55.0	21	42.9
Partial task trainers (injection pad, IV arm)	8	40.0	29	70.7
Full-body high-fidelity manikin (life-like computerized manikin)	3	15.0	27	87.1
Full-body simple manikin	3	15.0	26	78.8
Standardized patients (trained, live patient actors)	2	10.0	26	89.7
Peer patients (other students in class)	2	10.0	33	75.0
Computer-based task trainer (IV trainer with haptic device)	1	5.0	21	63.6
Full-body medium-fidelity manikin (some basic electronics)	1	5.0	25	73.5
Virtual reality systems (computer system w/headset and/or gloves)	0	0.0	16	66.7

Additional Analyses

Both academic nursing programs and hospital orientation personnel were asked to indicate whether their organization had an official definition of a medication error. The nursing program data are reported in summary to prevent disclosure of any individual program or type of program. Of the 35 nursing programs that responded to the item, 8 (22.9%) stated they had a definition, 14 (40.0%) stated they did not, and 13 (37.1%) responded they were not sure. Twenty hospital participants responded to the question and 13 (65.0%) reported that they had a definition, 2 (10.0%) reported they did not, and 5 (25.0%) reported that they were not sure.

Additionally, the hospital representatives were asked if their organization had a policy to limit distractions or interruptions while RNs were administering medications. If the question was answered yes, then a second question was presented asking whether the participant thought the policy was completely effective, not effective at all or somewhat effective. Of the 20 organizations that responded to this question, 13 stated that they did not have any policy related to distractions or interruptions and 7 reported that they had a policy that limited distractions and interruptions. Of the seven who indicated they had a policy, two stated the policy was completely effective, one said it was not effective at all, and four reported that the policy was partially effective.

It was identified that the clinical focus of the hospitals/hospital systems did not provide a close representation of hospitals in NC, so additional analyses were carried out to evaluate the similarities in orientation program experiences across different types of facilities. The orientation review topics, teaching strategies, activities and equipment

related to medication management were evaluated across acute care, psychiatric, rehabilitation, and long-term acute care facilities. Review topics and teaching strategies were found to be similar across all types of facilities. The greatest difference was seen in the activities and equipment used to prepare new nurses for medication management, with a larger percentage of acute care facilities including care equipment in the orientation experiences. This was not unexpected based on the differences in patient populations. Additional details are provided in Table 32 and 33.

Table 32

Comparison of NC Hospitals/Hospital Systems in NC with the Hospitals/Hospital Systems in the Sample

	Hospitals/Systems in NC		Hospitals/Systems in Sample	
	<i>n</i>	%	<i>n</i>	%
Acute care	108	82.4	19	61.3
Psychiatric	9	6.9	5	16.1
Rehabilitation	4	3.1	4	12.9
Long-term acute care	10	7.6	3	9.7

Table 33

Orientation Medication Management Review Topics by Hospital/System Clinical Type

	Acute care	Psychiatric	Rehabilitation	Long-term acute care
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Review Topics				
Policies and procedures	19 (100)	5 (100)	4 (100)	3 (100)
Medication error causes	16 (84.2)	4 (80.0)	4 (100)	3 (100)
Medication error reporting	19 (100)	5 (100)	4 (100)	3 (100)
Dosage calculation	15 (78.9)	4 (80.0)	3 (75.0)	3 (100)
Equipment operation	17 (89.5)	5 (100)	4 (100)	3 (100)
Use of electronic health record (EHR)	19 (100)	5 (100)	4 (100)	3 (100)
Use of medication administration record (MAR or eMAR)	19 (100)	5 (100)	4 (100)	3 (100)
Other review topic	1 (5.2)	0	0	0
Note: Other topic listed was a pharmacology review.				
Teaching Strategies				
Lecture	17 (89.5)	4 (80.0)	3 (75.0)	2 (66.7)
Nurse preceptor one-on-one with a new graduate	16 (84.2)	4 (80.0)	3 (75.0)	3 (100)
Computer/web-based assignment	15 (78.9)	5 (100)	4 (100)	3 (100)
Simulated clinical experience (any type of simulation)	6 (31.6)	1 (20.0)	1 (25.0)	1 (33.3)
Tutorial (lab setting with one teacher and one or two new nurses)	6 (31.6)	2 (40.0)	2 (50.0)	1 (33.3)

	Acute care	Psychiatric	Rehabilitation	Long-term acute care
	v (%)	n (%)	n (%)	n (%)
<u>Activities & Equipment</u>				
Bar-code scanner	18 (94.7)	4 (80.0)	3 (75.0)	2 (66.7)
Electronic health record (EHR)	16 (84.2)	3 (60.0)	2 (50.0)	2 (66.7)
Smart infusion devices (IV pump with drug database)	16 (84.2)	3 (60.0)	2 (50.0)	2 (66.7)
Basic equipment (medicine cups, syringes, medicine cart)	13 (68.4)	3 (60.0)	3 (75.0)	3 (100)
Electronic medication dispensing cart/machine	13 (68.4)	3 (60.0)	2 (50.0)	1 (33.3)
Computer-based programs (dosage calculation, clinical scenarios)	10 (52.6)	4 (80.0)	3 (75.0)	2 (66.7)
Partial task trainers (injection pad, IV arm)	8 (42.1)	3 (60.0)	3 (75.0)	2 (66.7)
Full-body simple manikin	3 (15.8)	0	0	0
Full-body high-fidelity manikin (life-like computerized manikin)	2 (10.5)	0	0	1 (33.3)
Standardized patients (trained, live patient actors)	2 (10.5)	1 (20.0)	1 (25.0)	0
Peer patients (other students in class)	2 (10.5)	2 (40.0)	2 (50.0)	0
Full-body medium-fidelity manikin (some basic electronics)	1 (5.3)	1 (20.0)	1 (25.0)	0

	Acute care	Psychiatric	Rehabilitation	Long-term acute care
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Computer-based task trainer (IV trainer with haptic device)	1 (5.3)	0	0	0
Virtual reality systems (computer system w/headset and/or gloves)	0	0	0	0

Summary

This chapter has described the findings of a study related to RN preparation for safe medication management. The three sample groups (new graduate RNs, prelicensure RN nursing education programs in NC, and acute care hospitals in NC) were described and inclusion and exclusion criteria identified. A detailed description of the demographic characteristics of each participant group was presented with supporting tables and the descriptive characteristics of each of the three study instruments were described. Findings were presented according to the study's specific aims and research questions with associated tables and charts. Two additional analyses were conducted related to the presence of an organizational medication error definition and policies limiting distractions during RN medication administration. The findings presented are discussed and linked to the study's supporting theory in Chapter 5.

CHAPTER V

DISCUSSION

This chapter provides a brief overview of the problem, a description of the purpose of this study, a review of the components of the theory of situated cognition, and an interpretation of the study findings in relation to the theoretical concepts. The study implications for education, practice, research and policy, as well as limitations will also be discussed.

Overview of the Problem

Although the need to reduce medical errors was clearly identified by the Institute of Medicine almost two decades ago (Kohn et al., 2000), and reiterated in 2007 (Aspden et al., 2007) and 2011 (Institute of Medicine, 2011), preventable harm continues to be a serious problem. It has been linked to 400,000 deaths every year in the US alone (James, 2013; Makary & Daniel, 2016). Medication errors play a large role in medical harm, affecting more than 1.5 million Americans every year and resulting in over 7000 deaths (Aspden et al., 2007). A number of interventions have been shown to successfully reduce medication error rates (Andrew & Mansour, 2014; Cousein et al., 2014; Donaldson, Aydin, & Fridman, 2014; US Food and Drug Administration, 2015), but the fragmented US health care system has failed to mount a coordinated effort to solve this issue.

One of the key components to reducing errors is to be sure health care providers are properly prepared to safely manage medications. Of all the health care workers who participate in medication management processes, the nurse is often the last person with the opportunity to intervene before an error occurs. This makes nursing education, orientation to the workplace, and competency assessment critically important. Unfortunately, there is little in the literature to guide nursing education or orientation programs on how to most effectively prepare new graduate RNs for safe medication management. The results of this study can contribute to the development of effective strategies and best practices for safe medication management instruction in nursing education and workplace orientation programs.

Purpose

The purpose of this study was to identify new graduate RN perceptions about medication error causes, associated behaviors, and safe medication management education. In addition, the study investigated how schools of nursing and workplace orientation programs prepared new graduate RNs for safe medication management.

Theory of Situated Cognition

The theory of situated cognition (Brown et al., 1989; Lave & Wenger, 1991; Smith & Semin, 2007) provides a useful framework for investigating nursing education and workplace orientation related to safe medication management because the concepts within the theory closely match the activities and interactions of real world practice. The theory is based on cognitive science and posits that learning is not just an internal

process, but external factors play a key role in learning and the ability to apply what is learned in a different setting or situation.

The concepts within the theory are community, tools, activity, context, and situated (Brown et al., 1989; Lave & Wenger, 1991; Paige & Daley, 2009; Stein, 1998; A. L. Wilson, 1993). Community represents the social environment and relationships in which an individual functions and is affected by the organization's culture, relationship patterns, and communications. Tools refer to the items that are used in daily activities and include physical artifacts, prior knowledge and technology. Activities are an individual's actions within a context, and for best performance or learning should be "authentic" or based on the real-world actions that the person is expected to learn or carry out. The concept of context provides structure for the three previous concepts. Context is the environment in which the community is placed, the tools are used, and the activities take place. The overarching concept of being situated emphasizes that learning (shaped by community, activities, tools, and context) and the application of learning are dependent on replication of the complexities and ambiguity of the real world during the learning experience. The applicable theoretical concepts are presented during the interpretation of the results.

Interpretation of Results

Sample

The sample consisted of new graduate RNs who were educated and working in acute care in North Carolina (NC), representatives from NC Board of Nursing approved schools of nursing educating prelicensure RN students in NC, and representatives from

acute care hospitals in NC licensed by the NC Department of Health and Human Services (NCDHHS). The gender of the new graduate RN participants was more reflective of US nurses with 11.6% males compared to 8.3% in NC. White respondents made up 81.3% of the sample, which closely matched NC RNs (81.7%), but there was a larger percentage of African American participants (16.7%) than is seen in NC (11.6%) or the US RNs (12.2%) as a whole. The sample was overrepresented by associate degree nurses (52.6%) compared to NC (39.7%) or the US (37.9%) and diploma graduates were underrepresented in the sample (1.1%). It is not clear why more associate degree nurses responded, unless there was an increase in this type of graduate in the period. Unfortunately, the graduation data for the 2015-2016 academic year are not yet available from the NC Board of Nursing. Diploma nurse participants may be small because there is only one remaining diploma program in NC (Health Resources and Services Administration, 2013; North Carolina Board of Nursing, 2016b, 2016c, US Bureau of Labor Statistics, 2016a, 2016b).

The RN education programs in the study were fairly representative of both NC and the US. The percentages of the programs participating fell between the numbers in NC and the US, except the diploma program participant percentage was higher than NC or US diploma programs (North Carolina Board of Nursing, 2016a).

The licensed hospitals in NC ranged from single unit, private specialty hospitals within another hospital facility, to large hospital systems with more than a dozen facilities and almost 3500 total beds (North Carolina Department of Health and Human Services, 2016). The variations in hospital structure and organization made it challenging to

contact the appropriate staff development personnel. Adding to the complexity was the fact that hospital systems use multiple methods to provide new graduate RN orientation: at individual hospitals, at one central location, at multiple regional locations, and a combination of methods.

There were some differences identified between the sample and acute care hospitals in NC. The 20 hospital/hospital system representatives that participated reported they provided orientation for 31 different types of hospitals. There was a lower representation of general acute care hospitals (61.3%) in the sample than are licensed by the NCDHHS (82.4%), and higher percentages in all other clinical types of facilities (psychiatric - 16.1%, rehabilitation – 12.9%, and long-term acute care – 9.7%) than seen in NC as a whole (psychiatric - 6.9%, rehabilitation – 3.1%, and long-term acute care – 7.6%). When orientation review topics, teaching strategies, activities and equipment related to medication administration were analyzed across facility clinical types, there was little difference seen in the review topics or teaching strategies used. There were more widespread differences seen in the types of patient care equipment and simulated experiences used. Acute care facilities included more equipment such as bar-code scanners, smart infusion devices, and electronic medication dispensing machines, which is not unexpected based on the differences in patient populations. Both the psychiatric and rehabilitation facilities reported a higher percentage of use of simulation experiences, especially peer patients, which may be an indication of the importance of communication skills in these clinical areas. It was somewhat surprising that not all of the facilities were

including the electronic health record (EHR) in safe medication management preparation because of its important role in error prevention.

Nurse Perceptions

Medication error identification, reporting, and causes. The first five research questions used the modified Gladstone scale to identify nurse perceptions of identification, reporting, and causes of medication errors. The vast majority of the nurses reported that they believed they knew what constituted a medication error (92.7%), and when to report an error using an incident report (83.6%). These findings were similar to other studies carried out in the US using the modified Gladstone scale (Mayo & Duncan, 2004; Osborne et al., 1999; Ulanimo et al., 2007), with reports of knowing what constitutes a medication error ranging from 84.2% to 92.6% and knowing when to report an error on an incident report ranging from 86.0% to 91.3%. These findings are notably higher than the studies which were carried out in Jordan (Mrayyan, 2012; Mrayyan & Al-Atiyyat, 2011; Mrayyan et al., 2007), which reported knowledge of a medication error reported from 61.1% to 82.8%, and knowing when to report on an incident report from 60.5% to 78.8%. One additional study from Turkey reported using the modified Gladstone scale (Unver et al., 2012), but the wording of the questions was changed significantly and did not provide comparable results.

A large majority of new graduate RNs (89.4%) reported that they believed some medication errors were not reported because nurses are afraid of the reaction of nurse managers or coworkers. Interesting, only 26.0% indicated that they might not report a medication error they made because they were afraid of disciplinary action or losing their

job. Fear of the reaction of others as well as punitive action by administration has been reported in studies around the world (Hajibabaei et al., 2014; Haw et al., 2014; K. S. Kim, Kwon, Kim, & Cho, 2011; Mostafaei et al., 2014; Treiber & Jones, 2010), and can be a major obstacle to accurate error reporting. These results are also very similar to the previous finding from the studies using the modified Gladstone scale in the US and Great Britain (Gladstone, 1995; Mayo & Duncan, 2004; Osborne et al., 1999; Ulanimo et al., 2007), but the number of participants who were concerned about possible disciplinary action or loss of their job was much higher in the Jordanian studies (40.5% to 52.4%) (Mrayyan, 2012; Mrayyan & Al-Atiyyat, 2011; Mrayyan et al., 2007).

Data related to events that new graduate RNs believed were medication errors, errors they thought should be reported to the patient's physician, and errors that should be reported on an incident report were gathered using the six scenarios presented in the modified Gladstone scale. Of the six scenarios, presented in Table 6 in Chapter 4, the nurses most frequently identified an incorrect intravenous infusion rate as an error (97.8%). Identification of a late medication as an error varied depending on the reason even though safe professional practices include medication administration at the "right time" as ordered (Donaldson, Aydin, & Fridman, 2014). Despite non-adherence to the practice standard of "5-rights" of medication administration, only 25.2% of participants thought a missed dose of antibiotic while a patient was away from the unit for a test was an error. Scenarios that required clinical decision-making, such as whether to administer a medication to a sleeping patient recently admitted with status asthmaticus, received about equal positive and negative responses, indicating that participant's self-assessment

of being able to identify a medication error may not be accurate. These results also seem to support the need for all organizations to have an official definition of a medication error. Only 22.9% of the nursing school participants in this study reported that their program had a definition of a medication error, with 40% stating they did not have one. It is difficult to teach new nurses what a medication error is if the faculty do not use a uniform definition. A greater number of hospital representatives reported having an official definition of a medication error (65%), with 25% indicating that they were not sure. This is a concerning report because if hospitals do not have a standard definition for a medication error then there is a chance that errors may not be identified or different individuals may categorize events differently and it will be very difficult to develop effective error prevention strategies.

Even when the respondents indicated that they did not think the scenario described a medication error, the majority thought that all the scenarios warranted reporting to the physician. A majority of the participants thought only two scenarios required an incident report, an incorrect intravenous rate (91.0%) and a late dose of antibiotic for a post-operative patient (60.5%). For every scenario, except when digoxin was held pending a lab report, more respondents indicated that an error had occurred than thought an incident report was necessary. This supports the description of underreporting of errors identified in the literature, and highlights the difficulty of addressing errors and error causes appropriately when error data are not available (Güneş et al., 2014; Haw et al., 2014; C.-C. Hung et al., 2016)

When nurse perceptions of medication error identification were compared to demographic characteristics, there was a general high level of confidence in all genders, age groups and degree types that they were able to identify a medication error. The one exception was the 40-49-year-old group where 20% of the participants indicated that they were not usually sure what constituted a medication error. There were similar findings for confidence in knowing when to report an error on an incident report. It is important to be able to identify and appropriately report errors so that error trends can be identified and addressed, but the confidence reported was not supported by the scenario responses. This discrepancy indicates an opportunity for education, and is in agreement with the new graduate RN observations that additional information is needed during orientation related to medication error definitions and reporting.

Also of concern were the perceptions of almost 80% of the participants that not all errors were reported due to concern about the reaction of the nurse manager or co-workers, and the report of one fourth of the nurses that they might not report an error they had made because they were afraid of possible disciplinary action or loss of their job. This indicates a lack of development of a culture of safety (Cloete, 2015; Sammer, Lykens, Singh, Mains, & Lackan, 2010). While nurses play a key role in reducing medication errors, they will only have limited impact if the organization does not develop a culture of safety that includes elements such as leadership, teamwork, evidence-based practices, communication, learning, justice, and patient-centered care (Sammer et al., 2010).

The top three error causes identified, using a 10-item ranking question from the modified Gladstone scale, were the nurse being distracted, the nurse being tired and exhausted, and when the nurse failed to check the patient's name band against the medication administration record (MAR). All of these reasons for errors are well supported in the literature (Abdar et al., 2014; Nelms et al., 2011; Popescu, Currey, & Botti, 2011; Prakash et al., 2014; Sitterding et al., 2014; Ulanimo et al., 2007), and indicate issues with individuals as well as policies. Policies to limit distractions and interruptions while RNs are administering medications have been shown to reduce medication errors, but they are only effective if supported by the organization. Staffing and workload policies, and in some states even laws, can have a notable impact on nurse fatigue, but just as it is the responsibility of the individual nurse to follow safe professional practices and check a patient's name band before administering a medication, it is also the nurse's duty to identify when their schedule or workload is putting them in an unsafe practice situation.

In eight previous studies using the modified Gladstone scale, four studies took place in England or the US (Gladstone, 1995; Mayo & Duncan, 2004; Osborne et al., 1999; Ulanimo et al., 2007) and four occurred in Jordan or Turkey (Mrayyan, 2012; Mrayyan & Al-Atiyyat, 2011; Mrayyan et al., 2007; Unver et al., 2012). Both being distracted and being tired and exhausted were in the top four causes of medication errors identified by nurses in the British and US studies. Also identified as a cause in three of the four studies was failure to check the patient's name band and physician writing being hard to read or illegible. In the Jordanian and Turkish studies, the top four causes

reported by nurses were related to errors with infusion devices, medication dosage calculations, or physician writing. One study reported distractions and two studies identified being tired or exhausted as the third or fourth most frequent cause of medication error. The differences may be related to the preparation of the nurses or the differences in the operations of the health care systems.

Similar findings were obtained when nurse-reported causes were analyzed according to gender, age group, type of degree, and work unit. Across the groups, almost all participants identified being distracted or being tired and exhausted as the most frequent cause of medication errors, with the nurse failing to check the name band as the third cause. Causes related to handling medications and dosage calculations were identified by participants as the second or third cause on units where the nurse is often responsible for more mixing or preparing, such as a pediatric or step-down unit, or where less variety of medications are administered, as in mental health/psychiatric. It is also notable that the most frequent cause of errors in the Specialty Services was setting up an infusion device incorrectly, although there were only three participants from the three areas in this category, and two of the three identified this cause even though they worked in different types of units. This may indicate a low volume/high risk area for an error prevention intervention.

Nursing education. As would be expected based on the theory of situated cognition, the courses identified by the largest number of new graduate RNs as providing effective preparation for safe medication management were the clinical experiences (first clinical 84.5%, and other clinical 91.3%). These courses would have encompassed all the

theoretic concepts by providing authentic activities in a real-world community of practice, as well as an opportunity to use the tools of the profession in a healthcare environment. It is possible that clinicals other than the first received the highest rating because they probably included a precepted experience, which would have been as close to independent practice as a student could experience. The next highest rated courses were a stand-alone skills course (79.4%) and the fundamentals course (78.4%) with its lab (78.1%). These courses often include authentic activities with realistic tools, but are not able to replicate the culture or personal relationships (community) or the environment (context) of a real health care setting. The classroom portion of the first clinical course (64.9%) and the pharmacology course (68.0%) were rated as effective by the smallest number of nurses. Since both of these were didactic courses, they would be the least like real-world clinical practice, and the lack of situatedness may have made it more difficult for the students to translate the information they provided into practical use. These courses are also often taught near the beginning of the nursing curriculum when the students have less knowledge about nursing and may find it harder to make meaning of the content delivered.

The teaching strategies that were reported as effective for learning medication management by the greatest number of nurses, once again, were the clinical courses: clinical group with some one-on-one with faculty (92.7%) and staff nurse preceptor one-on-one with a student (92.1%). A lab course (80.9%) or tutorial (85.3%) was identified most frequently as effective following the clinical experiences, followed by simulation (76.3%). It is interesting that simulation is identified this far down on the list because of

its potential to replicate the real world. This may be an indication of inconsistent quality in the application of simulation as a teaching pedagogy, and the need for continued improvement in the fidelity of the experiences. The two strategies identified as effective by the least number of nurses were lecture (72.2%) and computer/web-based assignments (37.3%). It is understandable that lecture might be considered less effective for learning medication management because it is one of the least situated teaching strategies when considering a nursing practice topic. What is surprising is the low rating of computer/web-based assignments, especially in light of the potential for interactive programming and even virtual reality. Students are often directed to the online resources associated with their textbooks when they need additional resources, but it is important for educators to know that this may not be an effective way to support their learning related to medication management.

The education activities and equipment identified as effective by the new graduate nurses also supported the importance of being situated. The closer the experiences were to the real-world, the higher the effective rating was: bar-code scanners (91.1%), smart infusion devices (89.0%), and basic equipment (medicine cups, syringes, medicine cart) (87.2%). Interestingly, only about half of the nurses thought peer patients (other students in class) (59.1%) or the use of a full-body simple manikin (54.0%) were effective for learning medication management. Congruent with the responses related to teaching strategies, simulation equipment such as medium-fidelity (61.8%) and high-fidelity (61.7%) manikins were seen as less effective than other equipment or activities. Computer-based equipment such as computer programs (62.9%), computerized task

trainers (58.6%), and virtual reality systems (43.8%) were all seen as less effective than the more clinically focused items despite their potential for contributing to a life-like learning environment. Because many of the lower ranked equipment items are very expensive, it is important for education programs to ensure that they have the curricular and faculty infrastructure in place to effectively utilize the potential of the equipment to enhance student learning. It is also interesting to note that of the few studies in the literature about effective teaching methods for safe medication management, most of the reports are related to the use of simulation (Aggar & Dawson, 2014; Amster et al., 2015; Ferguson et al., 2014; Pauly-O'Neill & Prion, 2013; Sears et al., 2010).

Reports of courses, teaching strategies, activities and equipment in effectively preparing new graduate RNs for safe medication management indicate little difference across gender, age groups and RN degree from what was reported by the participant group as a whole (see Tables 16, 17, and 18 in Chapter 4). Overall, clinicals received a greater number of effective responses than labs, and labs more than didactic courses. The one exception to this was the fundamentals course which was rated more closely to a lab than a classroom course. The more than 20% difference in the simulation effectiveness percentages between the degree programs may indicate differences in the application of simulation as an instructional tool, and is worth further investigation because simulation is one way to provide a close to real-world clinical learning experience in an on-campus setting, when the best practice standards are followed.

The activities and equipment used that most closely related to actual clinical practice (bar-code scanner, electronic medication dispensing cart/machine, and smart

infusion devices) received the most ratings of effectiveness across groups. Unexpectedly, the use of an EHR was not rated by a high number of participants as effective. This lower than expected report may be due to the challenges of effective implementation of the complex EHR system within an education program.

It also should be considered that the teaching strategy can impact the identified effectiveness of the activities and equipment. It is much less likely that a lecture will be provided about an electronic dispensing machine or an infusion pump, rather than having the individual actually practice operating it. One of the most common tools in nursing school skills labs are full-body simple manikins, but across all groups, except for the 50-59-year-old group of two participants, the manikins were identified by approximately 56% of the participants as effective for learning medication administration (42.9% to 66.7%). This highlights the importance of choosing the tool carefully for the teaching topic.

Medium- and high-fidelity manikins had similar results as were seen for simulation as a teaching strategy. Interestingly, fewer of the youngest nurses (20-29) found these items effective than the 30-39 or 50-59 age groups. There was a great variability of reported effectiveness in the computer-based activities and equipment with 36% of the males rating computer-based programs as effective, 75% listing computer-based task trainers effective, and 100% identifying virtual reality systems as effective for learning medication management, as compared to 60.8% of females rated computer based programs as effective, but only 56.6% and 41.0% rated computer-based task trainers and virtual reality systems as effective. This difference in rankings may be due to the

increased physical interactivity of the task trainer and the virtual reality system. A greater number of the associate degree nurses consistently ranked the computer based training equipment as effective, as compared to the baccalaureate nurses. It is unknown if this is because computers have been more effectively integrated into the associate degree curriculum or baccalaureate students use alternate experiences that they find more effective. Overall, the findings related to the nurse-reported effectiveness of courses, teaching strategies, activities, and equipment across all groups are congruent with the results for the entire sample, with few exceptions, and support the premise that the more situated a learning experience is, the easier it is for the learner to apply that new knowledge or skill into a real-world setting.

Recommendations for change in education programs. The new graduate RNs were asked to respond to one open-ended question about what could have been done differently in their nursing education program to better prepare them for safe medication administration. After review and coding of the responses, five themes were identified: more practice opportunities, safety, pharmacology course, enhanced instruction, and time/stress management. The theme with the most statements was more practice opportunities. Participant statements included “more clinical or lab time for medication preparation and administration”, “more time spent in lab, more equipment available for hands on learning”, “more opportunities available to actually distribute medication to the patients during clinical time”, and “more Sim labs.” These statements highlighted the nurses’ desire for the use of more authentic activities and tools during their education experiences which would have facilitated the transfer of new knowledge into an actual

practice setting. These comments also match the courses, teaching strategies, activities and equipment that the greatest number of respondents identified as effective.

Statements related to the theme of safety such as the recommendation to change “the focus from drug cards and extensive knowledge about the drugs...to safe administration” and “more emphasis on the reality of medication errors and what can be done to prevent them” indicated that the participants desired more practical information that would help them learn how to function safely in the nursing practice community. Stating that nursing programs should “put more emphasis on the effects, administration perimeters [sic], and other critical thinking administration information” indicates that as new practitioners they recognized that they wished their nursing program had included educational experiences that more closely matched the complexity of the real world.

It is interesting that although only 68% of those who took a pharmacology course in their nursing program rated it as effective, the need for a required, robust pharmacology course was one of the main themes in the participant’s comments. The statements were very specific such as the need for a “mandatory pharmacology course” or “a more thorough pharmacology class.” This leads to the question of whether the pharmacology class is not very effective as a means to prepare new nurses to safely administer medications, or is the problem the way the course is being presented. Overall, classroom courses were identified less frequently as effective for teaching medication administration, so it is possible that a more interactive and authentic version of the course would be more effective.

The last two themes both related to educational needs identified by the nurses. Statements related to enhanced instruction identified the need for more interactive and real-world experiences and less lecture. Requests for “more patient scenarios” and “more complex questions...real life issues such as patients off floor, late administration of medications due to patient load and care” was also a request to situate the instruction in the community of practice---make it real. The time and stress management theme also addressed the reality of practice and the desire to be better prepared to cope with the complexity that the participants faced as new nurses in the “real world” of nursing.

Workplace orientation. Similar to nursing education courses, the workplace orientation review topics that the nurses reported were the most effective were those that were more interactive and easily related to real-world practice situations: use of the MAR or eMAR (90.6%), use of the EHR (87.6%), and equipment operation (86.5%). Despite the fact that the participants reported a desire for more information in their nursing education programs about medication error causes, error reporting, and policies and procedures, these topics were identified by notably fewer respondents as being effective for medication administration preparation than the more hands-on topics (61.6%, 64.6%, and 71.4% respectively). Because it is not known what teaching strategy was used to present each topic it is possible that the topics with lower effectiveness ratings could have been presented using a perceived less effective manner, such as lecture.

Overwhelmingly, the most effective teaching strategy for safe medication management preparation identified by the participants was a nurse preceptor one-on-one with a nurse (100%). As with the academic educational experiences, working with a

preceptor provided the closest thing to a perfectly situated learning environment. After a preceptor, the greatest number of nurses reported that simulation experiences (82.5%) were effective, followed by a tutorial lab (81.8%) where one teacher worked with one or two nurses. It is important to note that only 60% of the respondents participated in simulation during their orientation and only 64% used a tutorial, but the participants who had access to these strategies found them very effective for medication management preparation. Less than half of the respondents identified lecture (47.7%) as effective and only slightly more reported computer/web-based assignments (52.1%) as effective. These findings are consistent with what the nurses reported as effective for the academic education programs.

Reports of effectiveness of the activities and equipment used in workplace orientation followed the same trend as that of academic education, with the more authentic experiences and tools placed in real-world environments receiving more reports of effectiveness: electronic medication dispensing carts/machines (95.6%), bar-code scanners (94.6%), and smart infusion devices (91.9%). Although approximately 60% of all participants had access to simulation experiences, various types were reported as effective: standardized patient (live, trained patient actors) (89.7%), high-fidelity manikin (87.1%), and simple manikin (78.8%). The experience with the lowest report of effectiveness was the computer-based program (42.9%) which is even lower than the effectiveness reported in academic education programs (62.9%).

Recommendations for change in workplace orientation. When asked what could have been done differently in their workplace orientation programs to better

prepare them for safe medication management the nurses responded with 38 pertinent phrases that were coded into four themes: medication management, policies and procedures, orientation structure, and orientation length. As would be expected for new graduate novice RNs, many of the statements related to medication management reflected a desire for more opportunities to practice with the tools in authentic activities that were related to their practice setting, such as the need for “more time working with the equipment”, a need to “emphasize the administration parameters and critical thinking for med administration for my specific floor”, “more emphasis on practicing calculating and remembering safe ranges (pediatrics)”, and “They could have used simulated scenarios more.”

Although a review of policies and procedures was reported by more than 98% of the participants as being included in their orientation, the fact that this was identified as an improvement theme indicates that either the content that was presented or the method that was used to present it did not meet the learning needs of the orientees. Participant comments included recommendation such as “have a specific review of hospital policy regarding what constitutes a med error”, teach new nurses “more about reporting med errors”, and “go over incident reporting in depth.”

Suggestions for improvement related to orientation structure included a desire for a residency program or focusing the residency program on the nurse’s assigned unit, and presentation of information related to errors before beginning patient care. The need to have well prepared preceptors was also identified by one participant who reported that there was “no clear guide how to precept and what needs to be taught.” A well-organized

orientation program that provides a transition to practice (TTP) for new graduates is critical in both retaining nurses and ensuring they are safe caregivers. Nurse residencies have been shown to support professional growth in areas such as clinical decision-making, leadership skills and hands-on care, as well as improve job satisfaction and retention (AL-Dossary, Kitsantas, & Maddox, 2014; Clark & Springer, 2012). A key piece to having a quality orientation program is to have trained preceptors. Adequate preparation of preceptors has been shown to improve the preceptor's ability to implement critical thinking strategies, be more efficient in their role, teach nurses with different learning styles more effectively, and improve new nurse retention (Cotter & Dienemann, 2016; Schuelke & Barnason, 2017).

Orientation length was clearly identified as an important factor by several participants based on statements such as “longer orientation”, “more time”, and “longer orientation with preceptor.” Six of the eight nurses who indicated that orientation time needed to be longer participated in a formal TTP program at their workplace. These responses could reinforce the need for a nurse residency or other TTP program for those who did not participate in one; they could indicate a need for the inclusion of more authentic or interactive experiences in the orientation process; or they could just be the expression of individual needs or desires for an extended period of support. Without being able to evaluate the actual program being reported on, it is not possible to identify a more specific response.

Nursing Education Programs

Representatives from RN prelicensure nursing education programs in North Carolina (NC) were asked to identify where in their curriculum safe medication management information was introduced, what teaching strategies were used for instruction of the material, and what activities and equipment were used in the classes where the material was taught. After reviewing the reported information, the experiences nursing schools reported were compared with what the nurses identified as effective courses, teaching strategies, activities, and equipment for learning safe medication management.

The schools of nursing reported that the primary courses where initial medication management information medication is taught were the fundamentals course (97.1% of participants) and the fundamentals lab (94.3% of participants). Less than half of the program respondents reported that other courses were used for initial instruction of medication management information, including clinical courses. Because data were only collected from one individual who taught the introductory medication management content at each nursing program, it is not known how familiar they were with all the courses in the curriculum where medication management was taught or reinforced. Further investigation is needed to determine where safe medication management is taught across nursing curricula, but the results of this study identify a potential need to intentionally include medication management instruction in more courses. This would increase the opportunities for reinforcement of knowledge and skills through multiple authentic learning experiences throughout a nursing education program.

The most common teaching strategy used by nursing schools for teaching medication management information was a lab course (97.1%) with lecture (94.3%) being the second most frequent strategy used. Clinical groups and simulation were both identified as being used by 80% of the nursing programs as a strategy to teach medication management, even though clinicals were only identified by 48.6% (first clinical) or 42.9% (other clinical) of the programs as a course where the information was being taught. The use of a nurse preceptor one-on-one with the student was only identified by 28.6% of the programs as a strategy used to teach initial safe medication information. From the perspective of situated cognition, clinicals, simulation, or a precepted experience could all be effective places to teach medication management because they are the most authentic and include the greatest number of elements to create a truly situated learning experience. It is possible that the nurse educators who completed the survey interpreted medication management as medication information (despite it being identified as (prepare, administer and monitor) on every question) and believed that the questions were asking more about knowledge acquisition rather than true management of the medication process. Clarification of this issue would require an investigation outside the scope of this study, but could be reflective of a generalized attitude in nursing education that needs to be addressed to adjust the learning experiences provided to students to better meet their learning needs.

There were noteworthy differences between the courses, teaching strategies, activities and equipment the nursing schools used to teach safe medication management and what the new graduate RNs identified as effective experiences to prepare them to

safely manage medications. The largest number of nurses reported the courses that more closely replicated actual clinical settings (other clinical course - 91.3%, first clinical course - 84.5%) were effective and the courses that least number of nurses thought were effective were the classroom based courses. This is almost the opposite of the courses nursing schools are using to teach students (other clinical course -31.4%, first clinical course -48.6%). Because the nurses were being asked to recall their experiences from as much as two or three years earlier, it is possible that what they remember as most effective was actually building on material that they had learned earlier. While it would not be practical to teach all medication management content in a clinical setting from a resources perspective, implementing some of the teaching strategies students identify as effective, such as increasing interactive experiences, use of real-world case scenarios, and clinical problem-solving, into the classroom may create a better fit with current student learning styles.

There was better congruence between the teaching strategies reported by the nursing schools and those seen as effective by new nurses with the exception of lecture. Lab courses were reported as being used to teach medication management by 97.1% of the nursing programs and they were reported as effective by 80.9% of the nurses. Clinical groups were considered by only 80% and precepted experiences by 28.6% of the nursing schools as a strategy used to teach medication management, but were thought to be effective by 92.7% and 92.1% of the nurses. It is not clear whether the nurses just remembered their clinicals as most effective because earlier courses did a good job of

preparing them to learn from the experiences, or if the experiences being situated in a healthcare environment actually facilitated learning new material.

Many nursing programs still rely on lecture to teach medication management, but it was rated as one of the least effective ways to learn by nurses (72.2%); only being ranked better than computer/web-based assignments (37.3%). These findings emphasize the need for the development of evidence-based guidelines for teaching medication management. The researcher can confirm that schools of nursing are reporting teaching medication management today the same way it was taught more than 30 years ago, despite that fact that the health care environment the new graduates are expected to function in is vastly different.

The same trend continued when comparing the activities and equipment the schools of nursing reported were being used to teach medication management and what the nurses believed are effective. The items that most closely match current clinical practice (bar-code scanners - 91.1%, smart infusion devices -89.0%, electronic medication dispensing carts/machines – 83.7%) were reported as used much less frequently by nursing programs (40.0%, 54.3%, 54.3% respectively). The two exceptions were basic equipment, reported as being used by 100% of the nursing programs and seen as effective by 87.2% of the nurses; and the EHR which 60% of nursing programs stated they were using and only 70% of the nurses reported it as effective. Some of the reasons more schools may not be using current health care technology that was rated so highly by the nurses is simply due to cost. Most of the more authentic items are also very expensive and require more training and technical support to be effectively integrate into

a nursing curriculum. Even when funding is available to purchase the equipment, there is often limited funding for faculty development to effectively integrate use of the equipment into the curriculum.

Hospitals/Hospital Systems

Hospital orientation can involve a generic orientation for all newly hired RNs, or, more commonly today, some type of TTP program (nurse residency or academy) for new graduate RNs. A TTP program usually provides additional content review and practice experiences in addition to the orientation given to all new RN employees. A TTP is also often longer than a generic orientation and includes preceptor support with gradually increasing autonomy (AL-Dossary et al., 2014; Barnett et al., 2014; Pittman et al., 2013). The new graduates reported that 80.7% participated in a TTP program that lasted from one to more than 12 months. The most frequent length was two to three months (28.4%).

Hospital orientation program representatives reported reviewing some of the same topics and using many of the same teaching strategies, activities and equipment as nursing education programs. The medication management review topics, which were very practice focused, were reported by a large majority of the new graduates as effective, but there was great variation in the effectiveness ratings of the teaching strategies used to review the medication management topics. One of the two most frequently used teaching strategies, a one-on-one preceptor (85%), was identified as effective by 100% of the new graduate participants, but the other most frequently used strategy, lecture (85%), was only rated by 47.7% of the new graduates as an effective strategy to review medication management information. This is consistent with previous

findings for nursing education teaching strategies, and quite likely reflects the desire of the new graduate RNs for more authentic learning environments. The two teaching strategies reported as least used by the hospitals representatives (simulated clinical experience -35.0% and tutorial – 30.0%), were rated as effective by a large number of new graduates (82.5% and 81.8% respectively). If the review of medication management information during orientation was presented in a more authentic manner, then the new graduates may find it more easily transferred to the clinical setting and possibly feel less of a need for additional time in orientation as reported in the recommendations for changes to workplace orientation above.

The activities and equipment used to review safe medication management with the new graduate heavily focused on technology and equipment use (bar-code scanners – 95.0%, EHR - 85%, smart infusion devices - 85%, basic equipment – 70.0%). Experiences that would replicate more of the complexity of a real-world clinical setting and require clinical decision-making or application of the nursing process to manage medications, such as a simple (15.0%) or high-fidelity manikin (15.0%) or a standardized patient (10.0%), were reported as being used by only a small number of participants.

Activities and equipment reported as most frequently used during workplace orientation for review of medication management were generally ranked as effective by the new graduate RNs. This may have been because the most frequently used items (bar-code scanners – 95.0%, EHR – 85%, smart infusion devices- 85%, basic equipment – 70.0%) were directly related to clinical care. Similar to the orientation teaching strategies and findings from the nursing education experiences, other less frequently used items

(standardized patients – 10.0% and high-fidelity manikins – 15.0%) were rated as effective by a large percentage of the new graduates (89.7% and 87.1% respectively), quite possibly because their use could provide a more realistic learning environment and an opportunity to put their knowledge and skills into practice in a safe setting. It is possible that the activities and equipment available for orientation, and therefore the frequency of use, is related to resource availability. Health care technology is readily available for review and practice within the hospital, but acquiring funding for expensive, specialized equipment designed for training purposes can be more difficult. This reinforces the need for evidence-based orientation program guidelines that identify the most effective methods for preparing new graduate RNs to safely manage medication.

Prior to a new graduate completing their orientation program it is important that their competency to safely manage medications be evaluated. The primary method used to evaluate competency reported by the hospital participants was through preceptor evaluation (95.0%). The second most frequently method was a computer-based test that was similar to a paper and pencil test (65.0%). Relying on preceptor evaluations raises two main concerns, is the preceptor adequately prepared to comprehensively and objectively evaluate a new graduate's competence related to a high risk clinical practice such as medication management, and is there time and opportunity to appropriately evaluate a preceptee while also providing care for patients? With concern about the adequacy of preceptor preparation as teachers cited in the literature (Boyer, 2008; Cotter & Dienemann, 2016) it may not be reasonable or prudent to place the burden of competency assessment on individual preceptors. Medication management safety is an

organizational quality issue and a transition to the use of authentic, coordinated organization-level competency assessment may have a greater impact on error reduction than dozens, if not hundreds of individual assessments.

Additional Analyses

Two issues that have been well documented in the literature as related to medication errors are the need for clear identification of an organizational definition of a medication error and the relationship between RN interruptions and distractions and medication errors. These issues were not addressed in the study research questions, but, because of their integral relationship with medication error reduction, three questions were asked in the surveys related to these issues and the results will be discussed here.

A clear definition of a medication error is important for guiding error prevention strategies and health care worker education. If nurse educators, preceptors, nursing staff, and administrators don't have a clear understanding of what constitutes a medication error, then it is very difficult to identify when an error has occurred and the appropriate steps to take to prevent it from happening again, both on a personal and organizational level. Nursing education programs and hospitals were asked whether their organization had an official definition of a medication error. As reported in Chapter 4, only 22.9% of the nursing school participants reported that their program had a definition of a medication error and 40% stated they did not have one. It is unclear how nurse educators can teach new nurses what a medication error is if the faculty do not use a uniform definition. An official definition was found more frequently at hospitals with 65% of the representatives reporting the presence of an official definition of a medication error and

25% indicating that they were not sure. These results are concerning because if a hospital does not have a standard definition of a medication error then there is a chance that different individuals may categorize events differently and it will be very difficult to develop effective error prevention strategies.

A reduction in RN distractions or interruptions during medication administration activities is a well-documented strategy to reduce medication errors (Donaldson, Aydin, & Fridman, 2014; Nelms et al., 2011; Prakash et al., 2014; Sitterding et al., 2014).

Limiting interruptions and distractions can be supported by organizational policy. In an effort to determine the prevalence of policies among the hospitals represented in this study, the participants were asked to identify whether their organization had a policy to limit distractions and/or interruptions and, if so, indicate whether they thought the policy was completely effective, not effective or partially effective. A policy to limit distractions and interruptions was reported at only 35% (7) of the participating organizations. Of the organizations reporting the presence of a policy, two stated they thought the policy was completely effective (28.6%), one reported it was not effective at all (14.3%), and four indicated that they believed the policy was partially effective (57.1%). Although limiting interruptions and distractions can reduce medication errors, it can have some drawbacks. Some nurses reported that they felt care coordination was negatively affected because they did not receive information about their patients in a timely manner, and other health professionals had to either wait to talk to them or were forced to go on to other duties without collaboration (Nelms et al., 2011). Others reported that sometimes family members or visitors would not contact them for needed

assistance or information (Verweij et al., 2014). Sitterding, Ebright, Broome, Patterson and Wucher (2014) identified that all interruptions did not have negative effects on medication safety and some nurses could prioritize interruption topics and continue to accurately track multiple tasks at the same time. The level of interruption that can be safely handled may also be a factor of the complexity of the cognitive task related to administering a particular medication, such as in a critical care unit or where chemotherapy is being administered. This is an area that needs further investigation to find the right level of isolation that is needed to safely process the tasks of medication administration without negatively affecting care coordination.

Usefulness of the Theory of Situated Cognition

The theory of situated cognition provided a framework for the interpretation of the findings of this study. A better understanding of how the experiences provided by nursing education and workplace orientation programs impacted learning related to medication management was achieved by applying the concepts of community, activities, tools, context and situated to those experiences. The nurse-reported effective learning experiences were able to be closely matched to the concepts in the theory, also demonstrating the utility of the theory for investigating educational events.

Implications for Nursing

Education

The ultimate goal of a nursing education program is to produce a safe, knowledgeable, and caring nurse. The findings of this study indicated that there was a gap between how nurses are being educated and what nurses perceived were effective

learning experiences to prepare them for safe medication management. If medication management, including associated practical and safety issues, was more intentionally integrated throughout all clinical experiences some of this gap could be addressed. Consideration should also be given to increasing interactive teaching strategies and learning opportunities that replicate real-world clinical settings, such as standards-based simulations, to facilitate the transferability of learning to actual practice.

Practice

Because of the clinical resources available in hospital orientation programs, many of the technological tools that are important in safe medication management are available during learning experiences. For education sessions that are not located in a clinical setting (not with a preceptor) it is important for orientation staff to understand that the more authentic the teaching strategy, the easier it will be for the new graduate nurses to transfer the information or skills into clinical practice. Lecture is a poor facilitator of the clinical application of knowledge.

There are numerous studies that have demonstrated the value of TTP programs, both for the organization and the nurse, and there are detailed resources available from the National Council of State Boards of Nursing (n.d.) that can guide the development or enhancement of a TTP program. To have a successful TTP program, it is also critical that preceptors are well prepared in teaching and evaluation strategies.

In addition to effective preparation for safe medication management, new graduate RNs need to demonstrate competency before they complete their orientation and begin independent practice. Currently, organizations report that they are primarily

relying on individual preceptors or computer-based testing that replicates a paper and pencil test. Because it is not possible to know in advance what clinical experiences the orientee and their preceptor will be presented with during the orientation, evaluation opportunities may vary greatly and not cover all critical tasks or knowledge.

Organizations need to be using a standardized competency evaluation that replicates the breadth of the complexity of real-world medication management. An assessment will never be able to evaluate every possible medication management scenario a nurse might encounter, but error data can guide evaluations so that they include both frequent activities and low volume/high risk medication events for a particular work area.

Research

This exploratory study identified numerous areas for further research. The findings provide a foundation for additional investigation and eventual development of evidence-based effective teaching strategies or best practices in both nursing education and workplace orientation programs. Further studies need to go beyond self-report of safe medication management instruction to determine what is actually being taught in nursing programs, how it is being taught, and what activities and equipment are being used in the instruction. These same studies need to be carried out in the workplace orientation. Only when current practices are clearly identified and evaluated can evidence-based decisions be made to improve safe practices.

Policy

One of the most challenging policy issues related to education at all levels is funding. Public education institutions can lobby their representatives for additional

support for educational resources such as equipment, facilities, and expert faculty. On a lower level, nurses can utilize the organization's structure to acquire grants and establish policies that ensure all employees responsible for the prelicensure preparation or orientation of new nurses are proficient in their roles (faculty, nurse preceptors, staff educators).

The lack of access to comprehensive error data is a major obstacle to making progress on reducing error rates throughout the US health care system. Most organization-level error data are tightly controlled due to the potential for legal action, so it is difficult to accurately identify the level of error that is occurring in the nation. Mandatory reporting of events has met with mixed success because of frequent punitive responses, whereas voluntary reporting has been challenged by underreporting, an inability to compare data across organizations because of differing error definitions, and a lack of report detail (Garrouste-Orgeas et al., 2012; Institute for Safe Medication Practices, 2000). The lack of a clear definition of a medication error and fear of punitive action translates all the way down to the practitioner level. The acceptance of a universal definition of a medication error, such as the one proposed by the National Coordinating Council for Medication Error Reporting and Prevention (2016), would provide a foundation for providers to know when an error had occurred, as well as making reported data more comparable across organizations. Error identification and reporting is a very complex topic and without agreed upon definitions and data sharing it is going to be very difficult to move on to wide-scale, effective error prevention.

Study Limitations

Bias

The use of an online survey may have introduced selection bias in the study because a certain level of computer expertise and internet access was required to participate. Because of the potential trend to use a mobile device for internet access in this age group, survey completion may have been negatively affected because the surveys were not completely optimized for mobile devices.

Sampling bias may have been a factor because the listing of all registered nurses (RNs) in NC acquired from the NC Board of Nursing identified initial licensure within a selected time frame, but there was no indication in the data whether the nurse was a new graduate or an RN from another state that was obtaining a license in NC for the first time. It also was not possible to identify whether a newly licensed nurse was educated in NC. More than half of the respondents (238) who indicated they wanted to participate in the study had to be excluded because they did not meet the inclusion criteria. An additional sampling limitation was that many of the e-mail addresses that the NC Board of Nursing provided for the nurses were school addresses that might not have been active or monitored a year after graduation, and even with those with valid e-mail addresses, there was no way to determine if the study invitation was ever seen.

Surveying the hospitals was challenging because the best list available of hospitals in NC was the licensed facilities list from the NCDHHS. The NCDHHS listing included a mix of individual hospitals and hospital systems and provided only a business mailing address. Because it was not possible to identify in advance whether new

graduate nurses were oriented at an individual hospital or centrally/regionally within a system, a study invitation letter was sent to each hospital. Ideally the invitation would have been sent directly to the person that was desired as a participant in the study, but that information was not available.

Generalizability

The schools of nursing and new graduate participant characteristics were fairly representative of the similar populations in of both NC and the US, with the exceptions that a larger percentage of African Americans were represented in the nurse participants than is present in NC or the US, and associate degree programs were over represented.as compared to NC and the US. The participant numbers were quite small for all samples so generalizability of the findings is limited.

Summary

Medication errors are a significant healthcare problem in the US. Nurses play a pivotal role in making or preventing errors because they are often the last member of the health care team who can stop an error before it reaches a patient. Only by effective and comprehensive preparation will nurses be ready for safe medication management.

This study identified deficits in nurse understanding of what constitutes a medication error, when an error needs to be reported to a physician, and when to report it on an incident report. An understanding of each of these topics is critical for providing safe care. The study also highlighted that there were differences between what nurses identify as effective content, teaching strategies, activities and equipment used in preparation for safe medication management, and the experiences that are being provided

in nursing education and workplace orientation programs. A lack of evidence-based education guidelines hinders improvements in these areas. Further research is needed to clarify what are the most effective methods for nurse safe medication management preparation. There are too many participants in the medication management process for one intervention to solve the problem, but by starting with one critical player, the nurse, progress can be made.

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APPENDIX A

UNCG NOTICE OF IRB EXEMPTION

To: Catherine Sykes
School of Nursing
sykesc2@gmail.com

From: UNCG IRB

Date: 10/03/2016

RE: Notice of IRB Exemption

Exemption Category: 2.Survey, interview, public observation

Study #: 16-0269

Study Title: An exploration of registered nurse preparation for safe medication management

This submission has been reviewed by the IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description:

The purpose of this study is to identify new graduate registered nurse (RN) perceptions about medication error causes, associated behaviors, and prevention education, as well as how new graduate RNs are being prepared for safe medication management during prelicensure nursing education, and workplace orientations. Three groups in NC will be surveyed: new graduate registered nurses (within first year of practice), hospitals, and schools of nursing with prelicensure RN programs.

Regulatory and other findings:

- This research meets criteria for waiver of a signed consent form according to 45 CFR 46.117(c)(2).

Investigator's Responsibilities

Please be aware that any changes to your protocol must be reviewed by the IRB prior to being implemented. Please utilize the most recent and approved version of your consent form/information sheet when enrolling participants. The IRB will maintain records for this study for three years from the date of the original determination of exempt status.

Signed letters, along with stamped copies of consent forms and other recruitment materials will be scanned to you in a separate email. **Stamped consent forms must be used unless the IRB has given you approval to waive this requirement.** Please notify the ORI office immediately if you have an issue with the stamped consents forms.

Please be aware that valid human subjects training and signed statements of confidentiality for all members of research team need to be kept on file with the lead investigator. Please note that you will also need to remain in compliance with the university "Access To and Retention of Research Data" Policy which can be found at http://policy.uncg.edu/university-policies/research_data/.

CC: Lynne Lewallen, Family and Community Nursing

APPENDIX B

NEW GRADUATE RN SURVEY

Q1.1 Information sheet approved by the IRB is attached here.

- ☐ I have read the information above and agree to participate in this study.
- ☐ I do not want to participate in this study.

Q1.2 Because your time is valuable, we would like to start off by asking you a few questions to be sure you meet the criteria to participate in this study. To ensure the questions display clearly it is recommended that you complete this survey on a desktop or laptop computer, rather than a mobile device.

Q1.3 Was the initial RN education program you graduated from located in NC?

- ☐ Yes
- ☐ No

Q1.4 Did you graduate from your initial RN education program before June 1, 2014 (any state)?

- ☐ Yes
- ☐ No

Q1.5 Are you currently working as an RN in an acute care setting in NC, e. g., hospital, surgical center?

- ☐ Yes
- ☐ No

Q1.6 Thank you very much for your willingness to participate in this study. Unfortunately, you do not meet one of the criteria to be included: graduated from an RN nursing program in NC, working in acute care in NC, and graduated from your initial RN education program after May 31, 2014. We wish you all the best in your future nursing endeavors! Please click the next page button to exit the survey.

Q2.1 The following questions will help us understand your views on medication errors and how we can better prepare new nurses to safely manage medications.

ErrCause Please put the statements below in order from the most frequent cause of medication errors (#1) to the least frequent cause (#10). To move a statement, place your cursor over the statement you want to move, then left click and hold with your mouse and drag it to the location where you think it belongs.

_____ Drug errors occur when nurses are tired and exhausted.

_____ Drug errors occur when nurses are distracted by patients, co-workers, or events on the unit.

_____ Drug errors occur when the nurse fails to check the patient's name band with the Medication Administration Record (MAR)

_____ Drug errors occur when there is confusion between two drugs with similar names.

_____ Drug errors occur when the nurse miscalculates the dose.

_____ Drug errors occur when the physician prescribes the wrong dose.

_____ Drug errors occur when the nurse sets up or adjusts an infusion device incorrectly.

_____ Drug errors occur when nurses are confused by the different types and functions of infusion devices.

_____ Drug errors occur when the physician's writing on the doctor's order form is difficult to read or illegible.

_____ Drug errors occur when medication labels/packaging are of poor quality or are damaged.

Scen1 Please select yes or no to indicate whether each scenario describes a medication error, if the event should be reported to the physician, and if an incident report should be completed. Scenario 1: A patient misses his midday dose of oral ampicillin because he was in X-ray for 3 hours.

	Yes	No
Medication error	<input type="radio"/>	<input type="radio"/>
Notify physician	<input type="radio"/>	<input type="radio"/>
Incident report necessary	<input type="radio"/>	<input type="radio"/>

Scen2 Please select yes or no to indicate whether each scenario describes a medication error, if the event should be reported to the physician, and if an incident report should be completed. Scenario 2: Four patients in a busy surgical unit receive their 6 PM dose of antibiotics 4 hours late.

	Yes	No
Medication error	<input type="radio"/>	<input type="radio"/>
Notify physician	<input type="radio"/>	<input type="radio"/>
Incident report necessary	<input type="radio"/>	<input type="radio"/>

Scen3 Please select yes or no to indicate whether each scenario describes a medication error, if the event should be reported to the physician, and if an incident report should be completed. Scenario 3: A patient receiving TPN feeding via an infusion pump is given 200 mL/hr instead of the correct rate of 125 mL/hr for the first 3 hours of the 24 hr. infusion. The pump was reset to the correct rate after the change of shift at 7 AM when the oncoming nurse realized that the pump was set at the incorrect rate.

	Yes	No
Medication error	<input type="radio"/>	<input type="radio"/>
Notify physician	<input type="radio"/>	<input type="radio"/>
Incident report necessary	<input type="radio"/>	<input type="radio"/>

Scen4 Please select yes or no to indicate whether each scenario describes a medication error, if the event should be reported to the physician, and if an incident report should be completed. Scenario 4: A patient admitted with status asthmaticus at 2 AM is prescribed albuterol (Ventolin) nebulizers every 4 hr. The nurse omits the 6 AM dose because the patient is asleep.

	Yes	No
Medication error	<input type="radio"/>	<input type="radio"/>
Notify physician	<input type="radio"/>	<input type="radio"/>
Incident report necessary	<input type="radio"/>	<input type="radio"/>

Scen5 Please select yes or no to indicate whether each scenario describes a medication error, if the event should be reported to the physician, and if an incident report should be completed. Scenario 5: A physician orders oxycodone hydrochloride and acetaminophen (Percocet) 1-2 tabs for post-operation pain every 4 hr. At 4 PM the patient complains of pain, requests 1 pill, and is medicated. At 6:30 PM the patient requests a second pain pill. The nurse administers the pill.

	Yes	No
Medication error	<input type="radio"/>	<input type="radio"/>
Notify physician	<input type="radio"/>	<input type="radio"/>
Incident report necessary	<input type="radio"/>	<input type="radio"/>

Scen6 Please select yes or no to indicate whether each scenario describes a medication error, if the event should be reported to the physician, and if an incident report should be completed. Scenario 6: A patient is receiving a routine 9 AM dose of digoxin every day. Yesterday's digoxin level was 1.8 (the high side of normal). A digoxin level was drawn at 6 AM today. At 9 AM the nurse holds the digoxin because the lab value is not available yet.

	Yes	No
Medication error	<input type="radio"/>	<input type="radio"/>
Notify physician	<input type="radio"/>	<input type="radio"/>
Incident report necessary	<input type="radio"/>	<input type="radio"/>

ErBeliefs Please indicate your level of agreement with each of the statements below.

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
I am usually sure what constitutes a medication error.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am usually sure when a medication error should be reported using an incident report.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Some medication errors are not reported because nurses are afraid of the reaction they will receive from the nurse manager or coworkers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would always report a medication error even if I didn't think the error was serious enough to warrant reporting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I might not report a medication error because I was afraid that I might be subject to disciplinary action or even lose my job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

NumEr How many medication errors do you remember making as an RN? (Drag the slider to indicate the number.)

_____ Number of errors

ErReport In your estimation, what percentage of all drug errors are reported to the nurse manager by the completion of an incident report? (Drag the slider to indicate the percentage.)

_____ Percentage of errors reported on incident reports

Q3.1 We would like to know more about your experience learning medication management in nursing school. When answering these questions, please think about all the experiences you had in your nursing program that prepared you to be an RN.

EdCrS How effective were these courses in teaching you new information about safe medication management (prepare, administer, & monitor)?

	Very effective	Effective	Neutral	Ineffective	Very Ineffective	Didn't take/ NA
Fundamentals of nursing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fundamentals lab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stand-alone skills course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pharmacology course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Classroom part of first clinical course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clinical part of first clinical course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Classroom part of other clinical courses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clinical part of other clinical courses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Another course (Please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

EdSet In what setting was new medication management content taught during your RN nursing program (not just reinforced from previous courses)? Select all that apply

- ☐ Classroom
- ☐ Clinical laboratory
- ☐ Simulation room/center
- ☐ Clinical agency
- ☐ Other (Please specify): _____

EdStrat How effective were these teaching strategies in preparing you to safely manage medications (prepare, administer, & monitor)?

	Very effective	Effective	Neutral	Ineffective	Very ineffective	Not used/NA
Lecture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lab course, e.g., one teacher with a group of students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tutorial, e.g., lab setting with one teacher and one or two students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clinical group with some one-to-one with faculty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Staff nurse preceptor one-to-one with student	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Problem-based learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Simulated clinical experience (any type of simulation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Computer/web-based assignment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

EdActEq How effective were these activities or equipment in preparing you to safely manage medications (prepare, administer, & monitor)?

	Very effective	Effective	Neutral	Ineffective	Very ineffective	Not used/NA
Basic equipment, e.g., medicine cups, syringes, pill cutter, medicine cart	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Partial task trainers, e.g., injection pads, injection buttocks, IV arms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer-based programs, e.g., dosage calculation, clinical scenarios, virtual hospital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer-based task trainers, e.g., IV trainer with haptic feedback	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual reality systems, e.g., computerized system with headset and/or gloves	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Full-body simple manikin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Full-body medium-fidelity manikin (some basic electronics)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Full-body high-fidelity manikin (life-like computerized manikin)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Standardized patients (trained, live patient actors)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peer patients (other students in class)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electronic health record (EHR)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electronic medication dispensing cart/machine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bar-code scanner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smart infusion devices, Alaris IV pump with drug database	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

EdDiff What do you think could have been done differently in your nursing education program to better prepare you to safely manage medications (prepare, administer, & monitor)?

Q4.1 Now we have a few questions related to your workplace orientation. When answering these questions, please think about all the experiences you had from the time you first started your job as an RN until you were considered "off orientation" and working independently.

OrTTP Did you participate in a formal program to assist new graduate RNs with transition to practice, such as a Nurse Residency, Academy, or Internship, in addition to what is provided for experienced RNs?

- ☐ Yes
- ☐ No

TTPTTime How long was your transition to practice program?

- ☐ Less than 1 month
- ☐ 1 month up to 2 months
- ☐ 2 months up to 3 months
- ☐ 3 months up to 4 months
- ☐ 4 months up to 5 months
- ☐ 5 months up to 6 months
- ☐ 6 months up to 7 months
- ☐ 7 months up to 8 months
- ☐ 8 months up to 9 months
- ☐ 9 months up to 10 months
- ☐ 10 months up to 11 months
- ☐ 11 months up to 12 months
- ☐ 12 months or more

OrTime How long was your orientation program?

- ☐ Less than 1 month
- ☐ 1 month up to 2 months
- ☐ 2 months up to 3 months
- ☐ 3 months up to 4 months
- ☐ 4 months up to 5 months
- ☐ 5 months up to 6 months
- ☐ 6 months up to 7 months
- ☐ 7 months up to 8 months
- ☐ 8 months up to 9 months
- ☐ 9 months up to 10 months
- ☐ 10 months up to 11 months
- ☐ 11 months up to 12 months
- ☐ 12 months or more

OrContent During your orientation/transition to practice program, how effective were reviews of these topics in preparing you to safely manage medications (prepare, administer, & monitor)?

	Very effective	Effective	Neutral	Ineffective	Very ineffective	Not reviewed/ NA
Policies and procedures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medication error causes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medication error reporting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dosage calculation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Equipment operation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use of electronic health record (EHR)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use of medication administration record (MAR or eMAR)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other topic (Please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

OrStrat During your orientation/transition to practice program, how effective were these teaching strategies in preparing you to safely manage medications (prepare, administer, & monitor)?

	Very effective	Effective	Neutral	Ineffective	Very ineffective	Not used/ NA
Lecture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tutorial, e.g., lab setting with one teacher and one or two new nurses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nurse preceptor one-to-one with new nurse	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Simulated clinical experience (any type of simulation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer/web-based assignment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

OrActEq During your orientation/transition to practice program, how effective were these activities or equipment in preparing you to safely manage medications (prepare, administer, & monitor)?

	Very effective	Effective	Neutral	Ineffective	Very ineffective	Not used/ NA
Basic equipment, e.g., medicine cups, syringes, pill cutter, medicine cart	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Partial task trainers, e.g., injection pads,	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

injection buttocks, IV arms						
Computer-based programs, e.g., dosage calculation, clinical scenarios, virtual hospital	○	○	○	○	○	○
Computer-based task trainers, e.g., IV trainer with haptic feedback	○	○	○	○	○	○
Virtual reality systems, e.g., computerized system with headset and/or gloves	○	○	○	○	○	○
Full-body simple manikin	○	○	○	○	○	○
Full-body medium-fidelity manikin (some basic electronics)	○	○	○	○	○	○
Full-body high- fidelity manikin (life-like computerized manikin)	○	○	○	○	○	○
Standardized patients (trained, live patient actors)	○	○	○	○	○	○
Peer patients (other new nurses)	○	○	○	○	○	○
Electronic health record (EHR)	○	○	○	○	○	○
Electronic medication	○	○	○	○	○	○

dispensing cart/machine						
Bar-code scanner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smart infusion devices, Alaris IV pump with drug database	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

OrDiff What do you think could have been done differently in your workplace orientation program to better prepare you to safely manage medications (prepare, administer, & monitor)?

MMTech Please select the medication-related technology items you have available where you work the majority of your RN hours. (Select all that apply.)

- ☐ Electronic medication administration record (eMAR)
- ☐ eMAR with bar-code scanner
- ☐ Computerized provider order entry (CPOE)
- ☐ Centralized electronic medication dispensing systems (Ex. Pyxis in the medication room)
- ☐ Bedside/mobile electronic medication dispensing system (Ex. Mobile computer with medication storage for a group of patients)
- ☐ Smart infusion pumps (Ex. Infusion pump with integrated medication database)
- ☐ Other care technology (Please specify): _____

DisIntPol Workplace distractions and interruptions have been identified as causes of medication errors. Distractions are generally anything that diverts your attention from what you are currently working on, e.g., noise, talking, movement, etc., whereas interruptions occur when another person or item requires you to stop what you are doing and shift your attention to a different action, e.g., answering a question, answering the phone, looking for a missing item, etc. Does the organization where you work the majority of your RN hours have a policy intended to limit distractions or interruptions while you are preparing or administering medications?

- ☐ There is a policy to limit distractions.
- ☐ There is a policy to limit interruptions.
- ☐ There is a policy to limit distractions AND interruptions.
- ☐ There are no policies to limit distractions or interruptions.

DIPEff Do you think the policy or policies to limit distractions and/or interruptions is/are effective?

- ☐ Yes, they are completely effective.
- ☐ No, they are not effective at all.
- ☐ The policy or policies are partially effective.

MEDef Does your organization have an official definition of a medication error?

- ☐ Yes
- ☐ No
- ☐ Not sure

METext If possible, please copy and paste your organization's medication error definition in the box below. If you cannot access a copy of the definition right now, please continue on to the next question.

MMComp How was your competency in safe medication management assessed during your orientation? Select all that apply.

- ☐ Paper and pencil test
- ☐ Computer-based test (similar to paper and pencil test)
- ☐ Computer scenario-based test
- ☐ Simulated clinical experience evaluation
- ☐ RN preceptor evaluation
- ☐ Competency was based on having successfully passed the NCLEX-RN exam
- ☐ Other (Please specify): _____

Q6.1 Now we would like to know a little more about you, so we understand who participated in our survey. Your answers are anonymous and will be combined with responses from all other survey participants. Responses will be reported as a group and it is not possible to identify the answers of an individual person.

Degree What degree did you complete to become an RN?

- ☐ Diploma
- ☐ Associates degree
- ☐ Bachelor's degree
- ☐ Master's degree

RNDate When did you graduate from your RN education program?

- ☐ After May 2016
- ☐ May 2016
- ☐ April 2016
- ☐ March 2016
- ☐ February 2016
- ☐ January 2016
- ☐ December 2015
- ☐ November 2015
- ☐ October 2015
- ☐ September 2015
- ☐ August 2015
- ☐ July 2015
- ☐ June 2015
- ☐ May 2015
- ☐ April 2015
- ☐ March 2015
- ☐ February 2015
- ☐ January 2015
- ☐ December 2014
- ☐ November 2014
- ☐ October 2014
- ☐ September 2014
- ☐ August 2014
- ☐ July 2014
- ☐ June 2014
- ☐ Before June 2014

RNLic When were you first licensed as an RN (any state)?

- ☐ After May 2016
- ☐ May 2016
- ☐ April 2016
- ☐ March 2016
- ☐ February 2016
- ☐ January 2016
- ☐ December 2015
- ☐ November 2015
- ☐ October 2015
- ☐ September 2015
- ☐ August 2015
- ☐ July 2015
- ☐ June 2015
- ☐ Before June 2015

EmpStat What is your employment status as an RN? (any position that requires an active RN license)

- ☐ Full time (36 hours or more per week)
- ☐ Part time (less than 36 hours per week)
- ☐ Not currently working as an RN

WkHrs How many hours per week, on average, do you work as an RN?

WkShft What shift do you primarily work?

- ☐ Day shift (Ex. 0700-1900 or 0700-1500)
- ☐ Evening shift (Ex. 1500-2300)
- ☐ Night shift (Ex. 1900-0700 or 2300-0700)
- ☐ Rotate shifts
- ☐ Other (Please specify): _____

WkDays What days do you primarily work?

- ☐ Weekdays (M-F)
- ☐ Weekends (S-S)
- ☐ Rotate days
- ☐ Per diem/As needed
- ☐ Other (Please specify): _____

WkUnit What type of unit do you work on the majority of your RN hours?

- ☐ Medical/Surgical
- ☐ Pediatric
- ☐ OB/GYN
- ☐ Mental health/Psychiatric
- ☐ Oncology
- ☐ Orthopedic
- ☐ Cardiology
- ☐ Neurology
- ☐ Rehabilitation (inpatient)
- ☐ Step-down
- ☐ Critical care
- ☐ Emergency department
- ☐ Operating room
- ☐ Post anesthesia care unit (PACU)
- ☐ Hospital float team
- ☐ Outpatient procedure clinic
- ☐ Outpatient surgical center
- ☐ Long-term acute care
- ☐ Outpatient clinic or doctor's office
- ☐ Other (Please specify): _____

WkPos What is your position where you work the majority of your RN hours?

- ☐ Staff nurse
- ☐ Charge nurse
- ☐ Manager/assistant manager
- ☐ House supervisor
- ☐ Director/assistant director
- ☐ Other (Please specify): _____

WkOrg What type of organization do you work in?

- ☐ Non-profit
- ☐ For-profit
- ☐ Public (government)
- ☐ Not sure

DOB Please enter the year of your birth.

Lang What is your preferred language?

- ☐ English
- ☐ A language other than English _____

Ethnic What do you consider to be your ethnicity?

- ☐ Hispanic or Latino
- ☐ Not Hispanic or Latino

Race Which of the following races do you consider yourself to be?

- ☐ American Indian or Alaskan Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Gender With which gender do you most identify?

- ☐ Male
- ☐ Female
- ☐ Transgender
- ☐ Not listed _____
- ☐ Prefer not to answer

OtherInfo Is there any other information you would like to share with us related to your experiences of learning safe medication management? If so, please enter your comments here.

APPENDIX C

NURSING EDUCATION PROGRAM SURVEY

Q1.1 Information sheet approved by the IRB is attached here.

- ☐ I have read the information above and agree to participate in this study.
- ☐ I do not want to participate in this study.

Q1.2 To ensure the questions display clearly it is recommended that you complete this survey on a desktop or laptop computer, rather than a mobile device.

Q2.1 Please tell us about your nursing program.

OrgType What is your school type?

- ☐ Public
- ☐ Private non-profit
- ☐ Private for-profit
- ☐ Other (Please specify): _____

SchType What type of organization is your nursing program a part of?

- ☐ University
- ☐ Community college
- ☐ Hospital-based school
- ☐ Technical school
- ☐ Other (Please specify): _____

NumFac How many nursing faculty does your school employ?

- ☐ Full time: _____
- ☐ Part time: _____

ProgType What program(s) do you have that lead to initial licensure as a registered nurse? Select all that apply.

- ☐ Diploma Average # of students per group/cohort _____
- ☐ Associate degree Average # of students per group/cohort _____
- ☐ Bachelor's degree (BSN) Average # of students per group/cohort _____
- ☐ Accelerated BSN (second bachelor's degree students) Average # of students per group/cohort _____
- ☐ Master's in nursing (first nursing degree) Average # of students per group/cohort _____

CrsFormat What is the format for the majority (> 50%) of courses in your prelicensure program?

- ☐ Face-to-face
- ☐ Online
- ☐ Hybrid or blended (face-to-face and online within one course)

MEDef Does your organization have an official definition of a medication error?

- ☐ Yes
- ☐ No
- ☐ Not sure

METext If possible, please copy and paste your organization's medication error definition in the box below. If you cannot access a copy of the definition right now, please continue on to the next question.

Q3.1 Now we would like to know more about what your students experience when learning safe medication management (prepare, administer, & monitor). Please think about how prelicensure RN students are educated when answering the following questions.

MMCrS In what courses is new information about safe medication management (prepare, administer, & monitor) taught to prelicensure RN students? Select all that apply.

- ☐ Fundamentals of nursing
- ☐ Fundamentals skills lab
- ☐ Stand-alone skills course
- ☐ Pharmacology course
- ☐ Classroom part of first clinical course
- ☐ Clinical part of first clinical course
- ☐ Classroom part of other clinical courses
- ☐ Clinical part of other clinical courses
- ☐ Another course (Please specify): _____

MMset In what setting(s) is new medication management content taught to prelicensure RN students (not just reinforced from previous courses)? Select all that apply.

- ☐ Classroom
- ☐ Clinical laboratory
- ☐ Simulation room/center
- ☐ Clinical agency
- ☐ Other (Please specify): _____

MMTStrat What teaching strategies do you use to prepare prelicensure RN students to safely manage medications (prepare, administer, & monitor)? Select all that apply.

- ☐ Lecture
- ☐ Lab course, e.g., one teacher with a group of students
- ☐ Tutorial, e.g., lab setting with one teacher and one or two students
- ☐ Clinical group with some one-to-one with faculty
- ☐ Staff nurse preceptor one-to-one with student
- ☐ Problem-based learning
- ☐ Simulated clinical experience (any type of simulation)
- ☐ Computer/web-based assignment
- ☐ Other (Please specify): _____

MMActEq What activities and/or equipment do you use to prepare prelicensure RN students to safely manage medications (prepare, administer, & monitor)? Select all that apply.

- ☐ Basic equipment, e.g., medicine cups, syringes, pill cutter, medicine cart
- ☐ Partial task trainers, e.g., injection pads, injection buttocks, IV arms
- ☐ Computer-based programs, e.g., dosage calculation, clinical scenarios, virtual hospital
- ☐ Computer-based task trainers, e.g., IV trainer with haptic feedback
- ☐ Virtual reality systems, e.g., computerized system with headset and/or gloves
- ☐ Full-body simple manikin
- ☐ Full-body medium-fidelity manikin (some basic electronics)
- ☐ Full-body high-fidelity manikin (life-like computerized manikin)
- ☐ Standardized patients (trained, live patient actors)
- ☐ Peer patients (other students in class)
- ☐ Electronic health record (EHR)
- ☐ Electronic medication dispensing cart/machine
- ☐ Bar-code scanner
- ☐ Smart infusion devices, e.g., Alaris IV pump with drug database
- ☐ Other (Please specify): _____

MMComp How is the medication management competency of your prelicensure RN students assessed? Select all that apply.

- ☐ Paper and pencil test
- ☐ Computer-based test (similar to paper and pencil test)
- ☐ Computer scenario-based test
- ☐ Simulated clinical experience evaluation
- ☐ Clinical faculty evaluation
- ☐ Competency is presumed based on successfully passing the NCLEX-RN exam
- ☐ Other (Please specify): _____

OtherInfo Is there any other information you would like to share with us about how you educate prelicensure nurses about safe medication management? If so, please enter your comments here.

APPENDIX D

HOSPITAL/HOSPITAL SYSTEM SURVEY

Q1.1 Information sheet approved by the IRB is attached here.

- ☐ I have read the information above and agree to participate in this study.
- ☐ I do not want to participate in this study.

Q1.2 To ensure the questions display clearly it is recommended that you complete this survey on a desktop or laptop computer, rather than a mobile device.

Q2.1 Please tell us about your nursing program.

OrgType What is your school type?

- ☐ Public
- ☐ Private non-profit
- ☐ Private for-profit
- ☐ Other (Please specify): _____

SchType What type of organization is your nursing program a part of?

- ☐ University
- ☐ Community college
- ☐ Hospital-based school
- ☐ Technical school
- ☐ Other (Please specify): _____

NumFac How many nursing faculty does your school employ?

- ☐ Full time: _____
- ☐ Part time: _____

ProgType What program(s) do you have that lead to initial licensure as a registered nurse? Select all that apply.

- ☐ Diploma Average # of students per group/cohort _____
- ☐ Associate degree Average # of students per group/cohort _____
- ☐ Bachelor's degree (BSN) Average # of students per group/cohort _____
- ☐ Accelerated BSN (second bachelor's degree students) Average # of students per group/cohort _____
- ☐ Master's in nursing (first nursing degree) Average # of students per group/cohort _____

CrsFormat What is the format for the majority (> 50%) of courses in your prelicensure program?

- ☐ Face-to-face
- ☐ Online
- ☐ Hybrid or blended (face-to-face and online within one course)

MEDef Does your organization have an official definition of a medication error?

- ☐ Yes
- ☐ No
- ☐ Not sure

METext If possible, please copy and paste your organization's medication error definition in the box below. If you cannot access a copy of the definition right now, please continue on to the next question.

Q3.1 Now we would like to know more about what your students experience when learning safe medication management (prepare, administer, & monitor). Please think about how prelicensure RN students are educated when answering the following questions.

MMCrS In what courses is new information about safe medication management (prepare, administer, & monitor) taught to prelicensure RN students? Select all that apply.

- ☐ Fundamentals of nursing
- ☐ Fundamentals skills lab
- ☐ Stand-alone skills course
- ☐ Pharmacology course
- ☐ Classroom part of first clinical course
- ☐ Clinical part of first clinical course
- ☐ Classroom part of other clinical courses
- ☐ Clinical part of other clinical courses
- ☐ Another course (Please specify): _____

MMset In what setting(s) is new medication management content taught to prelicensure RN students (not just reinforced from previous courses)? Select all that apply.

- ☐ Classroom
- ☐ Clinical laboratory
- ☐ Simulation room/center
- ☐ Clinical agency
- ☐ Other (Please specify): _____

MMTStrat What teaching strategies do you use to prepare prelicensure RN students to safely manage medications (prepare, administer, & monitor)? Select all that apply.

- ☐ Lecture
- ☐ Lab course, e.g., one teacher with a group of students

- ☐ Tutorial, e.g., lab setting with one teacher and one or two students
- ☐ Clinical group with some one-to-one with faculty
- ☐ Staff nurse preceptor one-to-one with student
- ☐ Problem-based learning
- ☐ Simulated clinical experience (any type of simulation)
- ☐ Computer/web-based assignment
- ☐ Other (Please specify): _____

MMActEq What activities and/or equipment do you use to prepare prelicensure RN students to safely manage medications (prepare, administer, & monitor)? Select all that apply.

- ☐ Basic equipment, e.g., medicine cups, syringes, pill cutter, medicine cart
- ☐ Partial task trainers, e.g., injection pads, injection buttocks, IV arms
- ☐ Computer-based programs, e.g., dosage calculation, clinical scenarios, virtual hospital
- ☐ Computer-based task trainers, e.g., IV trainer with haptic feedback
- ☐ Virtual reality systems, e.g., computerized system with headset and/or gloves
- ☐ Full-body simple manikin
- ☐ Full-body medium-fidelity manikin (some basic electronics)
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- ☐ Peer patients (other students in class)
- ☐ Electronic health record (EHR)
- ☐ Electronic medication dispensing cart/machine
- ☐ Bar-code scanner
- ☐ Smart infusion devices, e.g., Alaris IV pump with drug database
- ☐ Other (Please specify): _____

MMComp How is the medication management competency of your prelicensure RN students assessed? Select all that apply.

- ☐ Paper and pencil test
- ☐ Computer-based test (similar to paper and pencil test)
- ☐ Computer scenario-based test
- ☐ Simulated clinical experience evaluation
- ☐ Clinical faculty evaluation
- ☐ Competency is presumed based on successfully passing the NCLEX-RN exam
- ☐ Other (Please specify): _____

OtherInfo Is there any other information you would like to share with us about how you educate prelicensure nurses about safe medication management? If so, please enter your comments here.

APPENDIX E

RANDOM DRAWING SURVEY

Q1.1 This concludes the survey. Would you like to be entered in a random drawing for one of eight \$25 Amazon gift cards or receive a summary of the findings of this study when it is finished?

- ☐ Yes
- ☐ No

Q1.2 Please indicate whether you would like to be entered in a random drawing for one of eight \$25 Amazon gift cards and/or receive a summary of the findings of this study when it is finished by selecting the appropriate statement(s) and entering your e-mail address below. Your e-mail cannot be associated with your survey responses.

- ☐ Please enter me in the random drawing.
- ☐ I would like to receive a summary of the findings of this study.
- ☐ A valid e-mail address must be entered here to be eligible for the random drawing or to receive a study summary: _____

Q1.3 Thank you very much for taking the time to help us improve patient safety!

Please click the next page button to submit your responses.